Firearms
in
Criminal Investigation
and
Trials

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Firearms
in
Criminal Investigation
and
Trials
An Integrative Approach

FIFTH EDITION

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PREFACE TO THE FIFTH EDITION

The book *Firearms in Criminal Investigation and Trials*, in the present avatar, is designed to be an integrated approach in Forensic Ballistics to all the professionals involved in the dissemination of justice and the students of Forensic Ballistics. The conglomerated fare caters most of the need of most of the persons who need to know the science of Forensic Ballistics.

Forensic Ballistics has been my favourite field of forensics activity from the very day I joined the Forensic fraternity. I have examined literally thousands of forensic ballistics cases and appeared as an expert witness thereof in all categories of courts, except Supreme Court[1] as an expert. I also had close contact/ encounters with hosts of investigators, lawyers, judges, medico-legal experts and Forensics scientists/students while being in the field (scenes of incidences), in the classrooms, in the courtrooms, in the post-mortem examination rooms, in the chambers of the judges/lawyers and in conference/meeting halls. My main observation has been that most of the persons involved consider Forensic Ballistics as a technical apparition and try to avoid confrontation. The apparition shadow, however, continues to lengthen overtime (terrorists activities, increase in violent crimes). Today, nobody concerned with Criminal Justice System can avoid the shadow. My endeavor has been to de-jinx the evil spell and eradicate the universal fear complex of Forensic Ballistics.

The present work proposes to overcome the fear complex with added vigour. It discards the pompous name of the subject 'Forensic Ballistics' and adopts user-friendly title *Firearms in Criminal Investigation and Trials*, which subject-wise it is. The book has been surmounting the deficiencies with ever-increasing vehemence with each new edition. The present edition takes another long step towards the goal.

The ballistics involved in Forensic Ballistics is simple. It is intelligible to all educated persons. The main Forensic Ballistics work is concerned with firearms/ ammunition/firing process/fired ammunition/ wounding phenomena, etc. They do not involve any higher mathematics in their evaluations. The present edition is completely free from mathematical complexities.

The endeavor was to keep the book informative, simple, intelligible, interesting whereby numerous photographs/illustrations/case histories/charts

1. The Apex Court does not hear/record original evidence; it usually appraises the recorded evidence. The Court has appraised my expert evidence in numerous cases and utilised the expertise discussed in my books in the dissemination of justice.

has been updated which serves the need of the professionals. I hope and pray that I have succeeded in the mission and the present submission remains concise, precise, comprehensive and an integrative fare for all concerned.

On demand of the readers, a few chapters have been added in this edition. The University students and academicians wanted elaborate discussion on Ballistics[1]. Three chapters on internal/external/terminal ballistics have been added. They also wanted to know the latest technology. A new chapter on Laboratory Equipment meets their needs of 'Latest Technology'. The Investigating Officers were sore that the handling of shooting scenes was not discussed in the previous editions. The sore point has been tackled and a new chapter on 'Shooting Scenes' has been added. Another chapter on 'Handgun Injuries' has been added. The courts and the counsels will be able to appraise these injures better.

It would have been criminal to ignore the recent advances in Science and Technology. The latest developments in Forensic Ballistics have been incorporated in the relevant and appropriate chapters.

No book is free of all errors in spite of best efforts of the author to make it so. The present presentation is no exception. The author shall be obliged if the errors and lacunae are brought to his notice. They will be acknowledged thankfully.

Suggestions for improvement are most welcome.

July 2017 **B.R. Sharma**

1. Not needed by non-experts in most of the cases.

PREFACE TO THE FOURTH EDITION

The publication of IV Edition of the book in spite of its being on a technical subject, speaks volumes of its need and its acceptability as to its format, contents and intelligibility. It is a serious problem to produce technical literature for non-technical professionals. This is especially so in Forensic Ballistics. Here the evidence has to be understood, appreciated and utilized by the non-technical persons: the judges and the advocate in courts and the investigator and administrator in the field. If the literature is not available in layman's language, the investigator will not be able to collect the correct clues correctly and the court will not be able to use it in the dissemination of justice. The judge will either discard the evidence altogether or accept the *ipse dixit* of the expert. Worse still he may accept the version of the loud mouth at the time of arguments. All these situations plague the dissemination of real justice.

A lot of water has gone under the bridge since the last edition of this book. The experts, the investigators, the prosecutors and the judges have been demanding revision of the book to include the sea-changes which Forensic Ballistics have undergone in recent times. It has been my endeavour to do the needful lucidly and correctly.

The present Edition addresses to all the major developments which have taken place during the last decade:

1. The steep rise in the violent crimes is mainly due to the manifold increase in the terrorist activities. They are misusing the latest weaponry and all types of explosives in their nefarious activities. The work of the Ballistics expert has not only increased, but new dimensions have also crept in. For example, in a terror strike, often the terrorist group has to be ascertained expeditiously, through arm-ammunition linkage. Not only that, sometime (it will be often in the coming times) it will be required to find out whether the same gang is responsible for the two (or more) incidents or different gangs are operating. New advanced technologies (automation) have come up. It can meet the new challenges. The technologies have been discussed in this Edition.
2. The terrorists are using explosives, now, almost in all their attacks. Previously the abuse was rare. Consequently the nature, working, identification and collection of evidence pertaining to explosives and linking the same with the perpetrators were almost unknown. Many a person, including ballistics experts who have often to work as explosive experts also wanted that a Chapter on explosives should be included in this book. It has been done in this Edition for the first time. It is hoped that the information therein meets the requirements, *vis-à-vis* explosives, of all the wings of the criminal justice system.

3. The linking of fired mutilated bullets, pellets and homemade projectiles fired from muzzle-loaders with the weapon and consequently with the shooter was often not possible. Likewise, it was difficult to establish the common source of gunshot residues. Trace elemental profiles of the clue materials and their corresponding sources can often establish linkage between the evidentiary clue and the source of origin, usually with the criminal. A Chapter on Trace Elemental Profiling has been introduced in this Edition.
4. India was formerly importing required firearms from various countries. Now Indian Ordnance Factories are manufacturing both arms and ammunition on fairly large scale. The details of the Indian arms and ammunition in not available in any book. As they are being used frequently in the commission of crime information on them was needed. The information has been included in this Edition.
5. Many a police case involving firearms end in acquittal. The main reason was inadequate and improper documentation of the evidentiary clues. Detailed documentation procedures to overcome the lacuna have been delineated in this Edition.
6. Case Law has been updated. A number of Supreme Court decisions have been included. They are bound to provide guidelines to all concerned in handling the evidence.
7. A number of new illustrations and new case histories have been introduced. It is hoped they make the subject more lucid and more easily intelligible.

I must repeat what I have said in the previous Editions that this book is no research thesis written from an ivory tower. It is based on more than four decades of personal practical experience in evaluating crime scenes, in handling exhibits in the laboratory and in presenting and appraising Ballistics evidence in courts. Besides, I have no hesitation to state that I have utilized the experience of all those who were and are involved in Forensic Ballistics and whose experience is available in books, journals, brochures, departmental manuals and circulars and on Internet. The information so gathered has been hashed and thrashed with concerned specialists individually and severally in seminars and meetings, in class rooms and lecture halls. Thus, it bears the hammering and honing of hundreds of experts, especially of ballistics experts, of police investigators, of legal luminaries and of students of Forensic Ballistics.

It is a comprehensive guide to handle Forensic Ballistics in its various facets. It is a guide for all those who are concerned with Forensic Ballistics.

The book is a practical multi-professional treatise, written in non-technical language, addressed to all those who are concerned with and deal with cases involving firearms: Administrators, Investigators, Experts, Counsels, Judges and even the public which suffers from the misuse of firearms.

It has been my endeavour to make this work free of errors. However acts of omission and commission do creep in. My apologies for the same. I shall be obliged if they are pointed out to me. Suggestions for improvements will be thankfully received and personally acknowledged.

October 2010 **B.R. SHARMA**

PREFACE TO THE THIRD EDITION

Terrorism, significant developments in the firearm technology, multifold increase in the misuse of the firearms and the information explosion in the field during the last two decades have necessitated extensive revision of the book. The main thrust in the revision has, therefore, been to induct in the latest developments particularly in the following sub-fields relevant to their influence on the forensic aspects of firearm related evidence:

1. The changed pattern of both civil and military small arms arsenal.
2. The tremendous progress made in handling GSR evidence.
3. The new insight into the wounding phenomena and the evaluation of the firearm injuries.
4. The ever-increasing abuse of the improvised firearms in India.

Forensic Ballistics, the firearm related evidence is a technical subject. The non-specialist professionals - the investigating officers, the lawyers and the judges - who are to utilise it in the dissemination of justice are somewhat hesitant to exploit its full potentialities. They feel that the subject is beyond them. It has been, therefore, my added endeavour, as before, to make the subject as non-technical as possible to make it more easily intelligible to the non-specialist. How far I have succeeded in this effort, I would love to know from my readers.

I have been very happy to receive feed back from the lawyers, the judges, the police officers, the specialist and the students of Forensic Ballistics on the last two editions of the book. In quite a few communications from the lawyers I was informed that they could get justice on the basis of the information and data contained in the book which they quoted in the courts. In other communications, especially from the specialist students, I was required to enlarge the data base and contents. I have tried to utilise all the suggestions consistent with the scope and the aims of the book. The new edition has, therefore, come up with extensive changes almost as a new book. The additions has increased the bulk of the book to almost twice its original size, in spite of my efforts to keep the size down by writing concisely, consistent with the clarity. The format of the book has not been changed but the contents have been rewritten and the latest information has been incorporated.

The book is not a research product. It is totally based upon the practical experience of the author in the field, in the laboratory and in the courtrooms. I have fully utilised the experience of the other experts in the field. It is believed that the book contains most of the information needed by the persons to whom the book is addressed. However the author shall be happy to provide any

additional information/expertise, when required. Besides, the specialist can get the information from the literature cited in the book.

It has been my endeavour to make the book precise. However I have no illusion that there will be no acts of omission and commission. I shall be obliged if they are pointed out. Any suggestions for the improvement of the book will be thankfully received and personally acknowledged.

2002 **B.R. SHARMA**

PREFACE TO THE SECOND EDITION

The First Edition of this book has been appreciated and praised by all: Forensic Scientists, Police Officers, Lawyers and Judges, alike. There has been hardly any criticism about its contents. Besides, no body has pointed out any mistake factual or otherwise, despite the fact that the book has been extensively used and reviewed.

The absence of criticism is a unique honour for any publication. This is especially so because of its multi-professional nature. It, therefore, calls for minimum changes, only to update the contents. Since the publication of the first edition of the book, Forensic Ballistics has made tremendous progress in two fields : Gunshot residues and improvised firearm evidence. The evaluation techniques of gunshot residues and their utilisation for identification of injuries, estimation of range, identification of projectile materials, etc., have made commendable progress. Likewise, researches in the evaluation of evidence relating to improvised firearms, commonly known as country-made firearms which are used in about 25 to 50% of total incidences involving firearms in various states of our country, have increased considerably their chances of providing positive linkage in crime cases involving the same. Updated information on these topics was, therefore, essential. The same has been provided. The case law on firearms has also been updated. The additional material forms PART II of the book.

It is hoped that the book in the latest form will be a complete guide on Firearm evidence to all concerned. All suggestions for further improvement will be thankfully received and personally acknowledged.

1990 **B.R. SHARMA**

FOREWORD TO THE FIRST EDITION

Dr. B.R. Sharma, whose monumental book on *'Forensic Science'* received wide acclaim from Judges, Lawyers, Magistrates and Police Officers and also from scientific circles, has written a new book on Forensic Ballistics—undoubtedly the most important branch of forensic science.

This is the most exhaustive treatise on Forensic Ballistics in existence. It deals with all aspects of this science and is not born out of work done only in the laboratory—though the laboratory plays a very important part—but he has put into it all practical aspects by taking the reader to the field. And not only that, he has argued it before the law courts where the evidence in any "Criminal case must be tendered and where it has to be finally appraised. The book is profusely illustrated and this helps even the lay reader to comprehend the facts easily.

Very few in the world have as much practical experience of Forensic Ballistics in the laboratory or in the field or even in the law courts as Dr. Sharma has. The deep theoretical and practical knowledge that he has gained during nearly two decades of his work in this field has left its imprint on this book.

Police Officers, Magistrates, Lawyers and Judges should all be grateful to the author for this excellent handbook on Forensic Ballistics. It is bound to have wide circulation in India and abroad.

B.N. MULLIK
Ex-Director
Central Intelligence Bureau
and
Founder-President
Indian Academy of Forensic Sciences

New Delhi
January 26, 1976

PREFACE TO THE FIRST EDITION

The scope, dimensions and areas of intensive activity in Forensic Ballistics have changed considerably in recent years, for instance:

(1) the identification of fired ammunition in respect of the firearm is accepted universally;

(2) the advent of scanning electron microscopy permits evaluation of the tiniest mark;

(3) neutron activation analysis and other techniques identify the minute powder residues;

(4) projectiles fired from smooth bore firearms can be identified in respect of the firearms;

(5) there is considerable progress in estimating the time of firing;

(6) there is an ever-increasing stress on reconstruction of sequence of events from firearm injuries and other available data;

(7) there is an ever-increasing incidence of frauds in Forensic Ballistics.

These developments have not been reflected in the books available on the subject. Consequently, the police officer, the lawyer, the judge and the student, who for obvious reasons cannot delve deep into the journalistic literature, have not kept pace with the developments. The present book proposes to fill up the gap. The book has been written in simple and non-technical language so that the professionals, who though not experts, have yet to utilize the expertise, are not overwhelmed by the complexity of the subject. An effort has also been made to meet the needs of the expert in the field, by adopting a comprehensive yet concise approach.

Forensic Ballistics as a branch of forensic science is a multi-professional subject. It was, therefore, essential to adopt an inter-professional format where the main requirements of the police officer, the scientist, the lawyer and the judge could be converged into a meaningful dialogue without professional bias. A conscious effort has, therefore, been made to do so. How successfully the intra-professional barrier has been crossed can be judged only by my colleagues in other involved professions.

Acts of omission or commission must have crept into the text in spite of my efforts to eliminate them. Indulgence of the reader is sought for the same. However, a reference about them will be thankfully received and personally acknowledged.

B.R. SHARMA

Chandigarh
February 23, 1976

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I gratefully acknowledge the advice, guidance, help and blessings of all those who have made it possible to carry out the exhaustive revision and produce the book *Firearms in Criminal Investigation and Trials* in its new Avatar, the IV Edition. But for their visible or invisible contributions it would not have been possible to induct in so much relevant new information on the subject. I am particularly thankful to:

- Shri. D.R. Sharma, who provided the needed encouragement and inspiration and more importantly his blessings, to carry out this onerous task.
- Smt. Veena, Mr. Anil Sharma, Mr. Aditya, Ms. Pallavi, Mr. Ashmit, Mr. Abdige and Mr. Sudarshan Sharma for providing all sorts of help in preparing the manuscript, drawings, photographs, illustrations and charts and providing other computer help in giving the final shape to the manuscript.
- Sarvshri R.K. Sharma and Mrs. Anjula Khajuria the advocates who have provided the necessary inputs relating to Chapters on **'Relevant Laws'** and **'Case laws'.**
- The Senior Forensic Scientists and Ballistic Experts who have helped, directly or indirectly, to make thorough revision possible: Dr. Shukla, Director, Dr. R.S. Verma, Director (Retd.); Mrs. Ash Dhir, Mr. Basoya and Dr. J.K. Sinha (all from CFSL, Chandigarh), Dr. Arun Sharma DD, FSL, HP; Dr. L.A. Kumar, D.D., F.S.L, Haryana, Madhuban (Rtd.); Thakur Rup Singh, D.D. (Rtd.), CFSL., CBI New Delhi; Dr. S.N. Sharma, Director F.S.L., Punjab Chandigarh (Rtd.); Dr. S.K. Jain DD, Dr. J.K. Modi, Shri Nigam (all from NICFS Delhi); Dr. S.N. Tewari, Agra, Dr. C.N. Bhattacharya CFS New Delhi; Dr. M.S. Rao, CFS (Rtd.); M.H.A., G.O.I., New Delhi.
- I also thank those persons whose works I have utilized unhesitatingly to make the book more useful to its readers.
- Most importantly, I am thankful to my publishers who have to bear with me for the vagaries of my time scheduling, and for the excellent job they have been doing all along to make this book such an excellent production.

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INTRODUCTION

1. IMPORTANCE

Firearms in criminal investigation and trials have been assuming an ever-increasing importance. This is mainly due to the following factors:—

1. Heinous crimes in which firearms are frequently used are increasing, in both volume and intensity.
2. The ballistics evidence, found at the scene or with the victim, links the criminal with the crime decisively, in most of the cases.
3. The definite nature of the evidence is easily understood and accepted by the courts.
4. The margin of error in the evaluation of the evidence is practically zero with competent experts.
5. The evidence is permanent for all practical purposes.
6. The renowned experts of the world have scrutinised and verified the ballistics evidence. They found it trustworthy.
7. The evidence is demonstrable and hence the non-experts can appraise the evidence without difficulty.

The easiest way to murder (and to get hanged for it) is through abuse of Firearms

Firearms are frequently involved in murders, attempted murders, accidental shootings, suicides, dacoities, robberies, rioting, police firings and police encounters and more recently in terrorist activities. They often jeopardise the lives and liberties of human beings. In fact, the word 'firearm' in criminal investigation spells serious crime – maiming, death, or murder. The society, therefore, views the use of firearms in crimes seriously and expects the keepers of law to prevent their misuse effectively.

Like fingerprints, the identification of fired ammunition in respect of the firearm used is definite. A fired bullet, extracted from a dead body or a fired cartridge case recovered from the scene of occurrence, can be linked/delinked to the used firearm positively, in most (over ninety percent) cases. If the firearm is of a suspect, the latter is linked with the crime, unless he proves that the firearm was not with him at the material time and somebody has stolen/taken it away.

The firearm evidence is now being used increasingly in many other dimensions:

1. In the verification of a version/hypothesis. The findings often determine whether the occurrence is a murder, a killing in self-defence, a suicide or an accident. Thus, the pleas of the parties involved that a particular firing was in self-defence, accidental or homicidal can be verified.
2. It is possible to determine the number of firearm-wielding assailants in some cases.
3. It allows the determination of time of fire, the range of fire and the number of shots fired.
4. The reconstruction of the sequence of events.

The gunshot residues (GSR) are present in almost all cases. Their evaluation was perfunctory in olden days. Their handling and examination have made tremendous progress in recent decades and their correct evaluations now help to:—

(1) Identify the shooter.

(2) Determine the range of fire.

(3) Identify a firearm injury.

(4) Ascertain the common source of ammunition in some cases.

The Scanning Electron Microscopy, Neutron Activation Analysis, Flame-less Atomic Absorption Spectrometry, Emission Spectrographic Analysis, LC-MS, and other highly sensitive and specific techniques, have facilitated the examination of the GSR.

The courts recognise the utility of firearm evidence. They give the evidence the same status as they give to the fingerprint evidence, and rightly so! The identification of firearms in respect of the fired ammunition in the last few decades, have acquired certitude like the one found in fingerprint identification. It requires competent experts, modern equipment and elaborate presentation techniques. There are many variables, which governs the registration of the marks on the ammunition. They need elaborate presentation mode for the evidence.

The protrusion and depressions on the various parts of a firearm are permanent for all practical purposes. The permanence of the firearm continues over a number of years, covering the life span of a case, if the weapon is kept properly and it is not tampered with. Cutting, filing, scratching, rusting, abrasion, acid action, etc., however, can destroy them. The damage due to actual wear and tear is too little to be of consequence for a number of years. Likewise, the identifying potential remains even after firing hundreds of shots in firearms encountered in criminal investigation.

The parts, coming in contact with the cartridge, show greater permanence than the barrel bore surfaces, which show greater wear and tear. It is due to abrading action ('washing') by the bullets and the hot gases. However, the 'washing' effect is not noticeable over a number of years or before firing a large number of shots. The first bullet and the thousandth bullet would permit the identification of the common source without any difficulty.

The permanency of the marks creating surfaces is because the firearm parts are made of steel. The items (projectile/cartridge cases mainly), affected upon, are made of comparatively softer metals or alloys. Thus, the ammunition is marked properly with the irregular patterns of the firearm parts, but the latter are not affected substantially. The patterns that the firearm surfaces acquire at the time of manufacture remain practically the same, if the firearm is kept properly. Slight changes do take place but they are so slow and gradual that they do not affect or interfere in linking the firearm with the ammunition fired through the same. These changes are like a few cuts and scars added on to a finger over the years, which do not hamper the identification of the fingerprint.

In the murder of a police officer, a shotgun was used. The culprit later deposited his gun in a court, where it was sealed. The fired cartridges recovered from the scene had only firing pin marks. Consequently, the fired shells could be linked to the gun only through firing pin marks. However, the firing pins of the gun were found to have been sawn off. The evidence that the firing pins of the gun had been cut was given. This fact corroborated other evidence to prove the guilt of the accused. $(CH)_1$

In another murder case, the culprit replaced the firing pin of the rifle used in the commission of the crime before the police seized it. The examination revealed that the firing pin impressions on the crime and test cartridges were different. However, breech face marks established the identity of the common source. $(CH)_2$

Firearm evidence is objective. It can be demonstrated through photographs, illustrations, charts, graphs and other devices. For example, if a cartridge case is to be identified in respect of a firearm, a test cartridge is, ordinarily, fired from the firearm and the class and individual characteristics are studied, compared and photographed. The counsels and the courts can appraise the photographs. In case of some doubts, the exhibits can be sent to a second or even to a third expert for the evaluation.

Some years ago, the author received a gun and two cartridge cases from a place not falling in the jurisdiction of his laboratory, to find out if the two cartridges had been fired from that gun. At the time of recording the evidence in the court, it was found that two other experts (one private and one government) had also examined the exhibits.

The private expert engaged by the State Government had given an indefinite opinion. The State Government consequently referred the case to two laboratories, one after the other. Both the laboratories found that the fired shell in question had been fired from the gun under reference. $(CH)_3$

2. PRINCIPLES

The basic principles of firearm identifications are the same as those for other identification involving comparison of the marks.

2.1 Principle of Individuality

The principle states that:

"Everything in this universe is unique. Neither nature has repeated itself nor can man."

It is well established that no two items in the world, whether natural or manmade, are identical. It was proved, experimentally in firearm-fired bullets/cartridges.

The various parts of a firearm: the barrel, chamber, firing pin, extractor, ejector and breech face, which are involved in the firing process, are made of steel. The final finished forms of these parts are achieved through a number of processes: cutting, filing, reaming, polishing, etc. The costly firearms are finally finished manually, whereas the cheaper firearms are processed through machines only. Whether it is a man or a machine which gives the final touches to the surfaces, they have distinct individual characteristics.

Why?

The tools, used for processing, are made of harder steel. Their surfaces coming in contact for cutting, filing, polishing, etc., change continuously, as they are being used against steel. The pattern of nicks and protrusions left on the finished surfaces by the changing cutting surfaces, therefore, also change continuously. Besides, the finishing processes are so haphazard and irregular and the applications of a tool always vary in number, angle, pressure, direction, etc. Further, the use, misuse, improper upkeep and rusting bring in changes in the relevant parts of the firearm and add to individuality of the thumb print of the firearms. Consequently, the finished surface characteristics are unique. They vary not only with firearms made by different firms or different men or with different tools but they also vary when the same firm with the same tools make firearms of the same model, even one after the other.

This individuality in firearms was demonstrated beautifully through an experiment carried out in the United States of America long back by Colonel Goddard, one of the pioneers in the field.

Colonel Goddard took a six feet long smooth bore barrel. He created lands and grooves in the barrel with steel cutters. He cut the barrel into six pieces and made six handguns. He fired six bullets, one each, from the six firearms. After keeping secret the identity of each of the six bullets-weapon pairs, he handed over the firearms and the bullets to experts to link the bullets to the firearms, which fired the bullets. The expert after carrying out the experiments came out with linkages. All the linkages were correct. $(CH)_4$

When a cartridge is fired, the pattern of protrusions and depressions is imprinted on the ammunition from those parts of firearm, which come in contact with the projectiles and shells under pressure. These mark patterns are called thumbprints of the firearms, emphasizing the certain nature of the evidence like that of fingerprints evidence. It permits identification of the firearm in the same way as a thumbprint identifies a man. The individuality of each firearm is now universally recognised.

The principle of individuality was dramatically revealed in a study involving super-imposition techniques. An effort was made to get two prints exactly alike from the same finger, using the same paper and ink and obtained one after the other; perfect superimposition could not be achieved. There were always some differences due to slight variations in pressure. Similar results were observed

in the fired cartridges and bullets fired from the same firearm, one after the other.

In the case of fired ammunition, the following variations are observed:—

(1) The number of marks differs.

(2) The marks have dimensional differences.

(3) The clarity of the marks varies.

(4) The accidental marks on one exhibit are not available on the other exhibits.

These variations are mainly due to the following factors:—

1. Different cartridges develop varying pressure. The force, therefore, with which the fired ammunition influences the firearm, varies from one shot to another. There are many factors, which create variations in pressure including defects in firearm/ammunition.
2. There are always some dimensional differences in different cartridge cases and bullets, which may give loose or tight fit, causing variation in the imprinted marks.
3. Extraneous particles like grit, sand particles, metal pieces, even fouling may cause variations in the marks.
4. Accidental scratches on the live ammunition may interfere with the imprinting of the marks. They may be confused with the thumbprint of the firearm.

Consequently, exact duplication of the marks is impossible.

2.2 Concept of Practical Identity

It has been observed above that two cartridges or bullets fired from the same firearm, even one after the other; do not carry marks that are exactly alike. Yet they are linked to firearm used. What is the basis of their linkage?

All identifications, definite or indefinite, consciously or unconsciously, are based upon the law of probability. It is a mathematical concept. It determines the chances of occurrence of an event in a particular way, from a number of ways in which the event can take place or fail to take place *with equal facility.* If P represents probability, N_s the number of ways of successful occurrence, N_f the number of ways of failure, the probability (P) is given by:

$$P = \frac{N_s}{N_s + N_f}$$

If the event consists of two occurrences, which can take place independently, the probability of the second occurrence is also given by the same formula. If digits 1 and 2 denote the first and second occurrences, the net probability P_T is:

$$P_1 = \frac{N_{s_1}}{N_{s_1} + N_{f_1}}$$

$$P_2 = \frac{N_{s_2}}{N_{s_2} + N_{f_2}}$$

$$P_T = P_1 \times P_2$$

$$= \frac{N_{s_1}}{N_{s_1} + N_{f_1}} \times \frac{N_{s_2}}{N_{s_2} + N_{f_2}}$$

If the event consists of 'n' independent occurrences, the net probability is given by:

$P_T = P_1 \times P_2 \times P_3 \times$.....$P_n$.

Consider the recovery of a pistol and a fired cartridge in a particular murder case. The class characteristics on the fired ammunition identify the make (say, one in twenty) and model (say, one in five models) of the firearm. Now there are three characteristic marks on the base from the breech face. These marks are rare (say, one in ten thousand each). The probability (calculated chance of occurrence) is:

P_1 (for make) = 1/20

P_2 (for model) = 1/5

$$P_3 \text{ (for three marks)} = \left\{\frac{1}{10,000}\right\}^3 = \frac{1}{10^{12}}$$

$$P_T = P_1 x P_2 x P_3 = \frac{1}{20} \times \frac{1}{5} \times \frac{1}{10^{12}}$$

$$\frac{1}{10^2} \times \frac{1}{10^{12}} = \frac{1}{10^{14}}$$

The identity of the fired cartridge in respect of the firearm is established beyond 'reasonable doubt'.

But if we were looking for exact identity of marks on the crime and test exhibits, we would be disappointed. Any cartridge or bullet fired from a firearm will carry some marks, which will not be found on a second cartridge or bullet fired from the same firearm. The lawyers, judges and experts must understand all these aspects of omissions and commissions before they can appreciate the concept of practical identity.

The identity of a common source of origin of two sets of marks is based upon the preponderance of identifying marks or individual features. Exact duplication of marks is not observed nor expected.

Calculation of probability needs extensive data, often not available in real life situations. However, if extensive research and studies have generated such data, then such mathematical calculations can be valid. Such data has been generated in the case of fingerprints, trace elemental profiles of glass, etc. and more recently in DNA profiling. The main question in these probability calculations is: what is the probability figure, which should determine the practical identity? The author

believes that if the probability figure is less than 1 in 10^{10} (10^{-10}) for alternative occurrence, identity is reached. This figure is based upon his extensive experience of decades. This is no magic figure. Practical identity may be achieved even with a smaller figure. However, this figure should eliminate all errors. The only requirement is that the data processed should be broad based and adequate.

2.3 Progressive Change

All firearms change with the passage of time due to use or abuse, wear and tear, weathering action of the atmosphere (rusting!) or improper upkeep of the firearm. The same is true for fired or unfired ammunition. Natural changes are, ordinarily, very slow except those due to rusting in warm and humid climate. Rusts accumulate inside the barrel, if it is not cleaned after firing. Oiling the barrel prevents rusting. Rapid firing may overheats the barrel and cause changes in the barrel characteristics. However, this happens only in war situations, not in criminal cases. There is no substantial variation in the barrel in normal criminal cases. Firearm/fired ammunition linkage is possible even after years in most of the cases. Intentional changes may, however, make the task difficult.

The period between the commission of a crime and apprehension of the accused is short. The natural changes, therefore, are insignificant for all practical purposes.

In case of an attempted murder, fired cartridges were linked with the weapon recovered from the suspect. The case came up for hearing after a long time. When the cartridges were examined in the court, the cardboard tubular portion, with identification marks had rotten. The identification had to be made through microscopy of the marks. (CH)

2.4 Principle of Exchange

Edmond Locard's principle that in contacts traces are exchanged mutually, is amply demonstrated in firearm evidence:—

(1) The fired shells and projectiles come in contact with the firearm and pick up marks from the firearm. They in turn, leave powder and metallic residues in the firearm.

(2) The projectiles hit the target. They deposit some traces at the site and pick up marks or material from the target. The latter aspect assumes great importance in ricocheted bullets. If a ricocheted bullet kills a person, the fact can be verified and the culprit cannot be charged with murder. It could be accident due to negligence only.

(3) A person who has handled a firearm is likely to deposit his fingerprints on the firearm. The person, in turn, may get smoke particles deposited on his hands and clothes.

(4) A projectile passing through an intermediate target leaves its telltale marks on that target. The projectile in turn picks up some traces from the same. For example, lead projectiles sometimes are imprinted with the cloth pattern from the cloth through which they pass.

(5) A bullet passing through a human body creates individualistic injuries. It picks up, in turn, blood flesh, bone pieces, etc.

2.5 The Problems of Proof

The basic problems of proof in firearm evidence relate to correct location, collection, transportation, evaluation and presentation of evidence. All these aspects are scrutinised by the court. The prosecution and the defence counsels help to appraise the evidence in all these aspects. The final verdict is that of the court. If the location, collection, packing or dispatch of the evidence has been defective, the evidence is often rejected, summarily. If the evaluation or the presentation is defective, the results are the same though these defects are rare.

In firearms-fired ammunition linkage, the proof is demonstrable. It can be appreciated/understood without any serious difficulty in spite of the fact that there are many variables involved. The expert must process the evidence properly and the lawyers and the judges must take active part without preconceived ideas and bias either in favour or against the expert evidence or the individuals involved.

3. SOME IMPORTANT COURT JUDGMENTS

3.1 Inordinate Delay

Appellant Dayanand is said to have surrendered before the Station House Officer on the 15th November, 1969 and is also said to have produced a country-made pistol. The High Court has not rightly relied upon the story of production of the pistol by appellant Dayanand. It is a peculiar characteristic of several cases in the States of Punjab and Haryana that the accused is found ready to surrender the weapons allegedly used in the occurrence. Be that as it may, although the pistol was sent to the Ballistics Expert, it could not be examined and proved by him that the pistol said to have been produced by the appellant Dayanand was the one from which a shot had been fired at Amar Singh. It may be stated here that a bullet on autopsy was recovered from the body of Amar Singh and another bullet was extracted from the buttock of Balbir Singh. The two bullets were also sent to the Ballistics Expert. The pistol and the bullets remained lying for a considerable time at his end but he did not find time to examine them. It appears from the records of the trial court that the Ballistics Expert wanted some more time to examine the materials and give his opinion. But since the court was in a hurry to close the case, the Public Prosecutor decided to give up the examination and obtaining of opinion of the Ballistics Expert.[1]

3.2 Prompt Dispatch

1. The police should not wait for the recovery of the actual weapon of offence before sending the empty cartridges or bullets, which are found near the scene of occurrence, for expert examination. No ground should ever be allowed for the attack by the defence that there was an opportunity for tampering with these empty cartridges while they remained in police custody.[2]

2. The courts below for cogent reasons rejected the defence contention and accepted the prosecution version that the appellant was taken into custody

1. *Chatter Singh* v. *State of Haryana*, AIR 1976 SC 2476.
2. *Mohinder Singh* v. *State of Punjab*, (1961) 63 Punj LR 434.

alongwith his gun, on the 24th December. The Apex Court found no fault with that reasoning. The gun having been seized by the police on the 24th, there was no scope for fabrication, nor any ground for doubting the genuineness of the empties picked up from the scene on the 18th December, and which on the 24th December were no longer in the possession or control of the investigating officer. They were as deposed to by Shri J.K. Sinha, P.W. 12, in the possession of the Forensic Laboratory since the 21st December.[1]

3.3 Negligent or Dishonest Investigating Officer

According to the post-mortem report there were gunshot wounds. The entrance wound was noticeable but not the exit wound. It was the duty of the medical officer to have directed X-ray examination of the dead body to determine if bullets were located in the body. It was the duty of the investigating officer to see if bullets were inside the dead body and those bullets, if recovered, were proved by ballistics examination to have been shot from the revolver which admittedly belonged to Srinivas from whose possession it was recovered. The Court made the impression that this omission cannot be but deliberate. It also observed that the matter was so patent that no investigating officer would ignore it.[2]

3.4 Qualified Expert

It was contended by the counsel that it has not been established in the case that P.W. 6 was entitled to claim that he was an expert so that evidence could be made admissible. Prosecution has not asked any questions to indicate that he had sufficient experience, training, knowledge and experience as to justify him to be called an expert and, as such, it was urged that his opinion could not be the last word on the subject. This part of the submission was not accepted, because no challenge was made in cross-examination. Besides, it is for the court to decide the question of competency or fitness of a witness who claims to be an expert. In this case the Court was satisfied that the learned judge before whom P.W. 6 was examined appears to have been satisfied that he was firearm expert. His competency cannot be now questioned.[3]

3.5 Improper Equipment

When his attention was drawn to some marks on photomicrograph and its negative, he (expert) stated:

> *"These are due to the fact that there were scratches on the lens of the microscope used by me."*

Obviously, a photomicrograph obtained with the help of such a defective microscope does not carry much value. The use of a defective microscope robs the expert opinion of much of its value.

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1. *Nachhattar Singh* v. *State of Punjab*, 1975 Cr LJ 66 (SC).
2. *State of Orissa* v. *Ramchandra*, AIR 1965 Ori 175.
3. *State of Bihar* v. *Hanuman Koeri*, 1971 Cr LJ 187 (Pat).

3.6 Database for Reports

Reports should be data based[1]:

1. In *State of Maharashtra* v. *Damu*[2] it has been laid down that without examining the expert as a witness in court, no reliance can be placed on an opinion alone. In this regard, it has been observed in *State (Delhi Admn.)* v. *Pali Ram*[3] that "no expert would claim today that he could be absolutely sure that his opinion was correct, expert depends to a great extent upon the materials put before him and the nature of question put to him".

In the article "Relevancy of Expert's Opinion", it has been opined that the value of expert opinion rests on the facts on which it is based and his competency for forming a reliable opinion. The evidentiary value of the opinion of an expert depends on the facts upon which it is based and also the validity of the process by which the conclusion is reached. Thus the idea that is proposed in its crux means that the importance of an opinion is decided on the basis of the credibility of the expert and the relevant facts supporting the opinion so that its accuracy can be crosschecked. Therefore, the emphasis has been on the data on the basis of which opinion is formed. The same is clear from the following inference:

> *"Mere assertion without mentioning the data or basis is not evidence. Even if it comes from an expert. Where the experts give no real data in support of their opinion, the evidence even though admissible, may be excluded from consideration as affording no assistance in arriving at the correct value."*

2. The next contention that, however, still remains to be determined is the value of the evidence of P.W.6. Learned counsel has contended that the record does not furnish the material, which had helped the expert in coming to his conclusion. The court has not the advantage of looking into those materials so as to hold that the expert was justified in the opinion he has given. Besides, the comparison photographs and other materials have not been produced and as such there can be no guarantee that the expert either examined the gun and the cartridge with the help of those materials at all. If on the other hand he had done so, whether his conclusions had been rightly arrived at, the Court observed that the submission must be accepted as correct. In the instant case, no material has been furnished and, therefore, the Court was unable to hold whether or not the firearm expert, namely, P.W. 6 had been careful in carrying out the necessary tests before giving his opinion as contained in the report and testified to the court. This is a serious infirmity in the prosecution case.[4]

3. The opinion given by Shri Prem Singh, Ballistic Expert, is bald and there is no data or reasons to arrive at the conclusion that the hole already there on the trousers of the injured could be caused by the pellet extracted from the calf of the injured. There is no opinion that the pellet extracted from the calf

1. Supreme Court of India: Criminal appeal no. 1237 of 2008. *Gurjinder Singh* v. *State of Punjab,* decided on 18-2-2011.
2. AIR 2000 SC 1691.
3. AIR 1979 SC 14.
4. *State of Bihar* v. *Hanuman Koeri*, 1971 Cr LJ 187 (Pat).

of the injured could be fired from the gun, Ex. 3, belonging to the appellant, nor could it be possible for the expert to give such an opinion because the gun was a muzzle-loading gun. The size of the shot recovered from the calf of the injured is .5075". There is no evidence of the size of the shots that were fired by the expert. The shot extracted from the calf of the injured was admittedly not fired by the expert in the test firing. Thus, his opinion that the hole found on the trousers of the injured could be caused by the pellet extracted from the leg of the injured cannot be accepted. This opinion cannot be called as an expert's opinion so as to corroborate the ocular evidence on record.[1]

3.7 Vacillating Expert

Shri Badul Rai, the ballistic expert, opined that the said two injuries could have been caused by a single shot fired from a country-made pistol. He deposed that if the shots were fired from a short distance of 8 to 10 feet all the pellets would have entered the body en masse and would have caused an exit wound thereby discrediting the evidence of the three witnesses that the shots were fired from 2½ to 3 yards. The witness, however, admitted that his estimate regarding the distance from which the shot was fired was based on standard ammunition and not country-made weapons. But when cross-examined he stated that the single shot must have been fired from a country-made weapon from a distance of eight feet. The fact that there was not tattooing or blackening is indicative of the fact that the shots were fired from not too short a distance. The High Court took no notice of Dr. Mathur's opinion in this behalf. The evidence of the three eye-witnesses as to the distance from which the shots were fired is a mere estimate. Even though the ballistic expert initially opined that injuries Nos. 12 and 13 could be the result of a single shot he vacillated and stated that the possibility of the said two injuries having been caused by two different shots could not be ruled out altogether. He merely stated that the greater probability was that they were the result of a single shot. In other words the ballistic expert was not positive in his view. In this nebulous state of the evidence of the ballistic expert the Court was of the view that the High Court was wholly wrong in doubting the direct evidence of the three eye-witnesses on this ground. Where the expert evidence is obscure and oscillating, it is not proper to discredit the direct testimony of the eye-witnesses on such uncertain evidence. In such a situation unless the evidence of the eye-witnesses is shaken by some glaring infirmities, it would not be proper to doubt the correctness of their statements. The Court was, therefore, of the opinion that the High Court was wrong in its conclusion based on the vacillating evidence of the ballistic expert.[2]

3.8 Photograph not Essential

It has next been argued that although the evidence of the prosecution showed that eight shots were fired at the time of the incident, the High Court erred in accepting the opinion of Ramiah (P.W. 23), who was a Firearms Expert of the Tamil Nadu Forensic Science and Chemical Laboratory, Madras, that all

1. *Gopal Singh Gorkha* v. *State of Uttar Pradesh*, 1991 Cr LJ 1239.
2. *Anvaruddin* v. *Shakoor*, 1990 Cr LJ 1269 (SC).

of them were fired from one and the same firearm. It has been urged that as no "empties" were found at the place of the incident, the eight shots could not have been fired from a pistol and the expert's opinion that they could have been fired from a revolver should not have been accepted as, even according to him, such revolvers with eight chambers were rare. It has also been argued that the evidence of the expert could not have been accepted because he did not take photographs for the purpose of comparing the land and groove himself by their comparison under "comparison microscope".

The Supreme Court did not think there is any real basis for this argument. Even if it were assumed for the sake of argument that the crime revolver had only six chambers and an eight chamber revolver was not available for the commission of the murders, there was nothing to prevent the appellant from reloading the revolver after firing the first two shots on hearing which Smt. Nagammal (P.W. I.) came from the threshold of the bed room to the drawing hall. Ramesh (P.W. 23) has stated that if the person using the revolver had been an expert, he would have required about a minute to reload it. The prosecution has led satisfactory evidence to prove that the appellant was an expert who had taken regular training in the use of firearms and had passed it with credit. If it would take a minute for an expert to reload all the six chambers, it would have been taken less than that time in replacing the two cartridges which were used in the first two shots. As it is, the evidence on the record does not exclude the possibility of such a reloading, and when an assassin who has received training in the use of firearm transcends at night into the house of his enemies with the intention of murdering them, it would be quite natural for him to replace the discharged cartridges. Much would not, therefore, turn on the question whether the appellant used a six or an eight chamber revolver in the commission of the crime.

In support of his argument regarding examination under the comparison microscope without the aid of photographs, Mr. Anthony has placed reliance on *State of Gujarat* v. *Adan Fateh Mohmed Unatiya,* (1971) 3 SCC 208. In that case the expert did not take photographs of the misfired cartridges, and admitted that the photographs were necessary for comparison. In that context this court made a reference to Burrad's "**The Identification of Firearms and Forensic Ballistics**", 3rd Edition, 1956, page 175, where it has been stated that any evidence of identification which is unsupported by photographs cannot be regarded as being anything more than an expression of opinion, and held that it did not establish that the test cartridges and the empty cartridges were fired from the same weapon or that the misfired cartridges was fired from the same weapon. That was, therefore, a different case which was decided on its own facts. It also appears that there was no evidence in that case to show that the comparison had been made with the help of a comparison microscope. The evidence of the expert, therefore, suffered from an inherent infirmity and was not satisfactory.

Counsel for the appellant however tried to refer to some observation from Hatcher's "Firearms Investigation, Identification and Evidence" for the purpose of showing the importance of photography and the use of enlarged photographs in such cases. Hatcher has devoted a whole chapter to photography

in investigation of firearms crime and while discussing the history of firearms identification he has pointed out the reasons why considerable importance was given to such photographs for the visual satisfaction of the judge and the jury. But while referring to the importance of photographs taken directly through the comparison microscope, he has devoted a paragraph to the decline in the use of micro comparison photographs and has gone on to state as follows:—

> *"There are also photographic reasons for the almost entire abandonment of this method of presentation. Unfortunately, the lenses of a camera do not adjust in the way that the human eye adjusts. The depth of field is extremely limited. Unlike the human eye, a photographic film has far less tolerance to variations in lighting. Photographs are almost always unsatisfactory to the expert who has made a positive comparison through the microscope. You photograph only what you can see at one single time. The camera cannot move along the surface of bullets to pick up identity after identity".*

The position has been stated as follows in section 178 (page 260) of Ehrlich and Jones' "Photographic Evidence" 1967, edition:—

> *"Usually more can be seen through a microscope than can be photographed through it. There are several reasons for this superiority of visual perception. In the first place, the eye looking through a microscope can scan the field and change focus at different points of the field. In addition, the eye can see any mental "filling in" is able to perceive form and detail that may not be recorded photographically. Moreover, the lens system of the microscope produces a curved field; this works out nicely for the eye since the retina is curved, but does not work so well photographically since the film plane is flat. Due to this latter defect, not all of the field will be photographed to the same degree of sharp focus, and some distortion may be produced in the photograph".*

It cannot, therefore, be doubted that a comparison microscope is the most important and most widely used scientifically instrument in comparing the crime cartridge with the test cartridge. Such microscopes are of various types but they have been described as follows in Volume I of Mathews' "Firearms Identification" on page 38:—

> *"A comparison microscope consists essentially of two compound microscopes, having identical optical systems, so connected by an optical "bridge" containing a combination of prisms such that by viewing two separate objects (one under each microscope) through a single eye piece the two objects may be compared by bringing the images of parts of each into juxtaposition".*

It has further been stated that when the desired condition is attained for purposes of comparison the bullets are said to be "matched", and correct opinion can be given thereon.

It is true that there has been considerable difference of opinion amongst investigators regarding the use of photographs in a court for the purpose of illustrating the matching of the markings, and while it may be that microscope

photographs, when taken with the due care and in the best of conditions, may enable the evidence to be placed on the record in a visible form, it cannot be denied that court would not be justified in rejecting the opinion of an expert who has examined the markings under the comparison microscope simply for the reason that he has not thought it necessary to take the photographs. It is, therefore, not possible for us to reject the evidence of Ramiah (P.W. 23) who has categorically stated that he had compared the land and groove markings on the bullets under a comparison microscope simply because he did not think it necessary to take the photographs.[1]

3.9 Acceptability of Forensic Ballistics Evidence alone Sufficient

While the sessions judge believed the testimony of the eyewitnesses, the learned judges of the High Court were of the opinion that they were unable to accept the assertion of the eye-witnesses that they actually saw the appellant with a pistol by the bed-side of the deceased. The High Court, however, relied upon the circumstantial evidence in the case in upholding the conviction of the appellant. There was motive for the crime and a few days before the killing of Daya Ram, the appellant had held out a threat against him. The appellant was arrested fourteen miles away from his village which is the place of occurrence. He produced a pistol (Ex. III) from his house in circumstances which clearly showed that he only could have known of its existence there.

The opinion of the firearms expert clearly established that the cartridge (Ex. I), found near the cot of Daya Ram, was fired with the pistol (Ex. III) produced by the appellant. All these circumstances, in the opinion of the High Court left no doubt that the appellant murdered Daya Ram by shooting him with his pistol.

The learned advocate for the appellant, urged that the appellant could not have placed the pistol in his house and it must have been planted there by someone because none of the witnesses stated that they had seen him going to his house after the murder and the appellant was certainly not found in his house in the morning. Both the courts below, however, found no reason to disbelieve the sub-inspector, and the witnesses that the appellant had produced the pistol (Ex. III) from the corn-bin inside his house. The appellant had the key of the house which was hidden in a secret place and the corn-bin was itself freshly plastered at one place. These circumstances clearly showed that no one but the appellant could have known of the existence of the pistol in the corn-bin of the house. As to whether the appellant could or could not have gone to his house after the occurrence, that is a matter of pure speculation. It does not appear that any witness was asked anything about it. The High Court found the witness might have caught a glimpse of the people who were fast disappearing from the scene but who had no reasonable opportunity of marking their features. In the confusion of the occurrence the witnesses may not have observed where the culprit had disappeared except that they were seen running towards the east. On the record there is nothing to show that to enter the appellant's house,

1. *Ramanathan* v. *State of Tamil Nadu*, 1978 Cr LJ 1137: AIR 1978 SC 1204.

after the occurrence, the appellant had necessarily to go into house within the view of the witnesses. It is quite unnecessary to examine this matter any further because the evidence concerning the production of the pistol (Ex. III) by the appellant from his house is clear and reliable and, therefore, it is certain that the appellant did enter his house after the occurrence without being seen by anyone.

It was next urged on behalf of the appellant, that it was impossible for a cartridge to have been near the cot of Daya Ram, because after the shot had been fired the cartridge would still remain in the barrel of the firearm. This again is pure speculation. That the cartridge was ejected from the firearm is certain. Why it was ejected, none can say. It may be that the miscreant reloaded his weapon to meet any emergency. The evidence of the sub-inspector is clear that on his arrival at the place of occurrence the cartridge Ex. 1 was handed over to him by the witness Khamani who cannot be said to be unfavourable to the appellant. The courts below had no reason to disbelieve the evidence in the case that the cartridge Ex. I was found near the cot of Daya Ram and we can find no extraordinary circumstance to justify us saying that the courts below took an erroneous view of the evidence.

The real question is, whether it is safe to act upon the opinion of the firearms expert that the cartridge Ex. I was fired from the pistol Ex. III produced by the appellant and none other, because without that evidence the circumstantial evidence in the case would be insufficient to convict the appellant of the crime of murder. The opinion of the firearms expert, based on the result of his tests, does not seem to have been challenged in cross-examination or before the High Court. If there is no reason to think that there is any room for error in matters of this kind and it is safe to accept the opinion of the expert, then clearly it is established that the cartridge Ex. I, found near the cot of Daya Ram, was fired from the pistol Ex. III produced by the appellant. To satisfy ourselves we have looked into the works of some authors dealing with the marks left on cartridge and shell cases by firearms in order to ascertain that there is no error in the opinion of the firearms expert in the present case. Kirk in his boom Crime Investigation at page 346 states:—

> *"Fired cases are less often encountered in criminal investigation than are bullets, but when found they are usually of greater significance because they receive at least as clear markings as do bullets, have a greater variety of such markings, and are not ordinarily damaged in firing.…*
>
> *The questions which may be asked as a result of finding such materials are similar to those that require answers when only bullets are located. In the ordinary case, quite definite answers can be given. This is true both of shotgun shells and of cartridge cases from pistols, revolvers, and rifles....*
>
> *In general, it is possible to identify a certain firearm as having fired a particular shell or cartridge, it is often possible to identify the type or make of gun which fired it, though in many instances this must be tentative or probable identification only.*

After dealing with the marks left by breech-block, firing pin impressions, marks from extractors and ejectors, marks due to expansion, magazine marks and loading mechanism marks, he states:—

Summarizing, the cartridge or shell case usually carries markings which are quite distinctive of the gun in which the charge is fired, and can be used for positive identification of the latter. These marks arise from a variety of contacts with various parts of the gun, an analysis of which is useful in determining the type of weapon in case no suspected gun is available... Thus, the recovered shell or cartridge case is one of the most useful types of physical evidence which can be found in shooting cases."

Soderman and O'Connell in their book Modern Criminal Investigation also deal with the subject and they refer to the marks from the firing pin, the extractor, the ejector, and the breech block. After referring to comparison being made of the cartridge or shell fired from a firearm for the purpose of test, they state at page 200:—

"If they are in the same position in relation to one another and their general appearance is the same, one may conclude that they have been fired from a pistol of the same make. An absolute conclusion about the origin of the shells, however, can be reached only after a photomicrographic examination of the markings from the breech block on the rear of the shell....

Identification, with the aid of the enlargement, should not prove difficult. The characteristic scratch can be easily seen. A photograph of the incriminating shell and one of a comparison shell should be pasted side by side on cardboard, and the characteristic marks should be recorded with lines and ciphers, following the same method as that used in the identification of fingerprints."

In Taylor's book on Medical Jurisprudence, 10th Edn., Vol. 1, at page 459, it is stated:—

"It is never safe to say that a cartridge case was not fired from a given pistol unless the marks are quite different, and a case which bears no marks at all may quite well have been fired from the same pistol as one which leaves well-defined marks. In general, however, though it is unlikely that all marks will be equally good, it is usually possible to obtain definite information from the marks of the firing pin, extractor, ejector or breech-block on the base or rim or from grooves or scratches on the surface. In weapons of the same manufacture the marks are of the same general nature, but in each weapon there are individual differences which usually enable it to be definitely identified."

The expert's evidence in this case shows that he had fired test cartridges from the pistol Ex. III. He found the individual characteristics of the chamber to have been impressed upon the test cartridge Exs. 9 and 10 and that exactly identical markings were present on the paper tube of the cartridge Ex. I. He made photomicrographs of some of these individual marks on Exs. 1 and 10. In giving his reasons for his opinion, the firearms expert stated that every firearm has individual characteristics on its breech face, striking pin and chamber. When a cartridge is fired, gases are generated by the combustion of the powder, creating

a pressure of 2 to 20 tons per square inch. Under the effect of this pressure the cap and the paper tube of the cartridge cling firmly with the breech face striking, pin and chamber and being of a softer matter the individualities of these parts are impressed upon them. By firing a number of test cartridge from a given firearm and comparing them under a microscope with the evidence cartridge, it can definitely be stated, if the marks are clear, whether the evidence cartridges had been fired or not from that firearm. It seems to us that the firearm expert made the necessary tests and was careful in what he did. There is no good reason for distrusting his opinion. The learned judges of the High Court examined the photomicrographs in question and were satisfied that there was no ground for distrusting the evidence of the expert. They were accordingly justified in coming to the conclusion that the cartridge Ex. I, found near the cot of Daya Ram, was fired from the pistol Ex. III produced by the appellant from his house. There can, therefore, be no room for thinking, in the circumstances established in this case, that any one else other than the appellant might have shot Daya Ram. He was, therefore, rightly convicted for the offence of murder.[1]

The appeal was accordingly dismissed.

3.10 Pellets (Buckshot) Identifiable[2]

The most important item of evidence against the accused, Paltan Mallah, is the report of the ballistic expert. PW-192, the Deputy Superintendent of Police of the CBI deposed that after the arrest of the appellant Paltan Mallah on 25-8-1993, he recovered one 12 bore country-made pistol, 13 live cartridges 12 bore, one foreign made pistol, 6 live cartridges of .38 bore and a motorcycle. The country-made pistol, the foreign made pistol and the cartridges were sent for examination by the ballistic expert to the Central Forensic & Science Laboratory, New Delhi. During the post-mortem of the deceased Shankar Guha Niyogi, three pellets were extricated from his body. These pellets were sent to Forensic Laboratory at Sagar and thereafter they were deposited in the court by PW-192 and these pellets were also later on obtained from the court and sent for examination by the CFSL. PW-159, the ballistic expert conducted detailed laboratory test-fires and microscopic examination and he gave Exh. P-398 report wherein he opined that three lead pellets marked P-1 to P-3 must have been fired from a 12 bore country-made pistol. He deposed that he had prepared the report on the basis of the microscopic examination and he had also taken photographs of the pellets and Exh. P-398 are the work-sheets of the report prepared by him.

The evidence of PW-159 and his report are seriously challenged by the counsel for the respondent accused. He extensively referred to the text books written by foreign ballistic experts such as Burrad, Hatcher and Taylor. It was argued that in the instant case, the weapon was a country-made pistol and the barrel was not grooved and there was absolutely no question of any identifiable marking coming on the pellets to enable the expert to give any opinion whatsoever. Reliance was placed by him on the observations of this

1. *Kalua* v. *State of Uttar Pradesh*, 1958 Cr LJ 300 (SC): AIR 1957 SC 180.
2. *State of Madhya Pradesh* v. *Paltan Mallah*, 2005 Cr LJ 918 (SC).

Court in *Ram Avtar* v. *Ram Dhavi*, (1997) 2 SCC 263: 1996 AIR SCW 4264: AIR 1997 SC 107: 1996 All LJ 1908 wherein this Court relied on the opinion of J.S. Hatcher in his text book of Fire Arms & Investigation to the effect that "unless there were rifling marks in the bullets which were not defaced by the entry in the bodies of the victims, no expert can ordinarily and generally give an opinion." It was also pointed out that in the case of country-made pistol, it was difficult to assume that the ballistic expert could have found identifying marks on the pellets. The evidence given by the ballistic expert was questioned in great detail. He was cross-examined extensively by counsel for all the accused. He deposed in the cross-examination that when these pellets are fired, then they among themselves would press each other inside the barrel [on inside parts] their effect could be on one side of inner side of barrel, they will take special individual mark on them and these marks will be in the form of a line on the pellets and if the barrel is tight then pellets will be more rubbed, and on more parts, lines will come. If barrel is tight then half part of the pellets are pressed and the barrel was nicely tight and the witness himself said that in the test fire which he did on all of the six pellets good marks of barrel had come. He had also stated that he had taken micro-photograph of only one pellet and had compared all pellets but he had not made any separate comparative record or photograph.

It was argued that micro-photographs were not produced and mere observation by the expert—was not sufficient and that he should have produced these photographs. The Apex Court did not think that there was any such necessity to produce the micro-photographs when the expert has given convincing reasons to support his opinion.

In brief, the problem of proof revolves round relevancy, authenticity, integrity, purity, sufficiency of the clue material and their proper evaluation of evidence, using well-recognised and standard tools and techniques and proper presentation of the evidence. All these aspects have been discussed in some details in the various Chapters of this book.

FIREARMS

SYNOPSIS

1. **GENERAL**
2. **PRIMITIVE FIREARMS**
   - 2.1 Matchlock Firearms
   - 2.2 Wheel-lock Guns
   - 2.3 Flintlock Guns
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   - 6.2 Currently used rifles in India are
     1. 7.62 Self-loading Rifle
     2. INSAS 5.56 Service Rifle

6.3 Service Rifles
1. Kalashnikov AK 47
2. Kalashnikov AK 74
3. G11: German Rifle
4. INSAS 5.56 Assault Rifle

6.4 Assault Shotguns

6.5 Indian Modern Sub Machine Carbine

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7.1 Parts of Revolvers
1. Barrel
2. Action
3. Solid Frame Revolvers
4. Break Frame Revolvers
5. Side Swinger Revolvers

8. PISTOL

8.1 Parts of a pistol
1. Action
2. Barrel
3. Magazine

9. MACHINE GUNS

9.1 Machine Guns

9.2 Light/Sub-machine Gun

10. MISCELLANEOUS FIREARMS

10.1 Air Rifle and Air Pistol

10.2 Cattle Gun

10.3 Stud Guns

10.4 Pest Guns

APPENDIX.—Indian Ordnance Factory Firearms

2

FIREARMS

The New Infantry Rifle—Excalibur

1. GENERAL

A firearm is a device to hurl projectile or projectiles with force[1]. The expansion of gases, usually produced by the burning of propellants creates the force. The expansion of compressed air is also utilised in air guns and air rifles.

The use of firearms started probably in the fourteenth century. The first firearm was not much of a firearm when compared with the modern firearms.

It was a straight metal tube, closed at one end and open at the other. The diameter of the tube varied (from about one centimetre to about three centimetres). The gunpowder was put into the barrel through the open end, the muzzle. No projectiles were used in the firearm. It was used to create noise and smoke to frighten the mounts of the enemies.

With the passage of time, the tube was fixed to a straight wooden stick with hoops and wires and covered with leather. Stone, lead, brass and iron (pieces and balls) were the first version of the projectiles. The powder and the projectile charge were filled through the muzzle and rammed into position. The lighting of the powder was done by a hot iron or burning stick. The firearm, thus became a dangerous weapon — the great leveller.

Improvements in the construction of firearms continued.

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1. According to the Arms Act, 1959 a firearm means arm of any description, designed or adapted to discharge a projectile or projectiles of any kind by the action of any explosive or other forms of energy and includes:—
   (1) Artillery, hand grenades, riot pistols or weapons of any kind, designed or adapted for the discharge of any noxious liquid, gas or other such things.
   (2) Accessories for any such firearm designed or adapted to diminish the noise or flash caused by the firing thereof.
   (3) Parts of and machinery for manufacturing firearms and cartridges, platforms and appliances for mounting, transporting and servicing artillery.

2. PRIMITIVE FIREARMS

2.1 Matchlock Firearms

The first primitive firearm was a matchlock firearm. It had the following important features:—

(1) The ignition was initiated through a touchhole. When the firearm was loaded, the powder would reach the touchhole. There, the powder could be ignited without much danger. It was an important feature. It reduced the chances of accidents considerably.

(2) A smouldering wick replaced the smouldering stick or a hot iron rod, to ignite powder charge. It was attached to an 'S' shaped metal piece. The wick could be brought to or taken away from the touchhole by manipulating the metal piece,

(3) The straight wooden stock was replaced by a curved stock. It could absorb the recoil better. It fitted to the shoulder, in shoulder arms and gave a better grip in handguns.

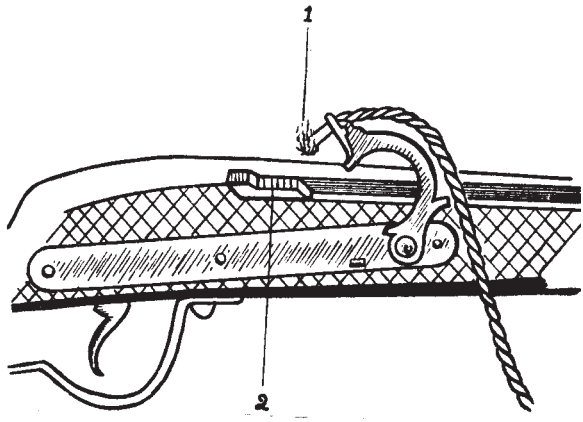


Fig. II-1

Match Lock Action

(1) Smouldering wick attached to a metallic lever is lowered by pressing the trigger. When the wick touches the powder in the flash pan around the touch hole, it sets it on fire.

(2) Flash pan.

The wick system of ignition suffered from some drawbacks. The wick had to be pushed forward and ash removed from time to time. Besides, the rain could extinguish it, or, the wind could fan it and consume the wick quickly. The system, therefore, gave way to the wheel-lock ignition mechanism.

2.2 Wheel-lock Guns

In wheel lock guns, a wheel with a corrugated circular edge surface could be put into motion by pressing a trigger. The wheel was so positioned that it struck against an iron pyrite piece placed over the touchhole. The friction produced sparks which fell upon the gunpowder contained in a depressed site, called flash pan, around the touch hole and lighted it, which in turn, put the gunpowder, contained in the barrel, on fire through the touch hole.

The wheel lock mechanism was complicated and costly. Flintlock device replaced it.

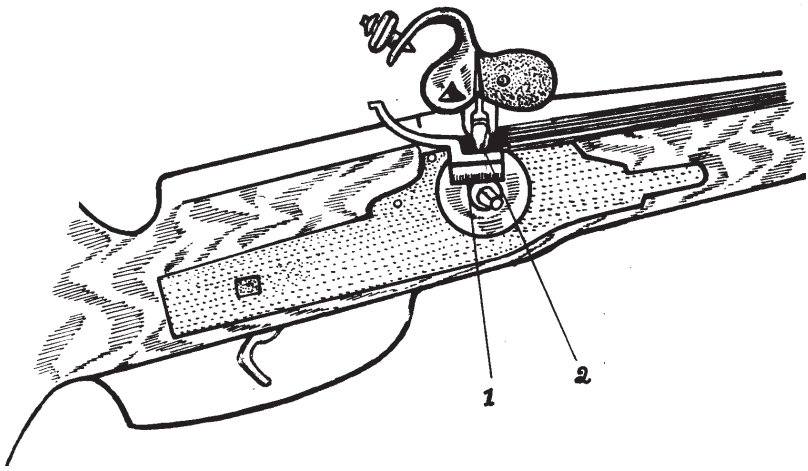


Fig. II-2

Wheel Lock Action

Wheel with corrugated surface contained in circular box (1) would revolve on pressing the trigger and rub against an iron pyrite piece (2) to generate sparks which would put the black powder, contained in the flash pan, on fire.

2.3 Flintlock Guns

In flintlock guns, a piece of flint was fixed to a jaw shaped device, like an ordinary gun-hammer (Fig. II-2), which could be operated with a trigger. On pressing the trigger, the hammer holding the flint would fall and strike a metal piece kept over the flash pan. The spark so produced lighted the charge in the same way as in the wheel lock system.

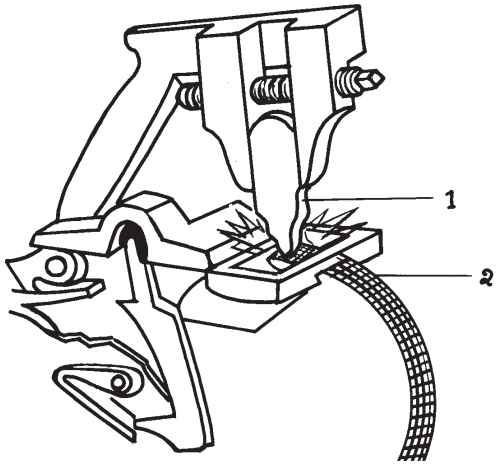


Fig. II-3

The friction of the iron pyrite piece (2) and the corrugated surface (1) in the wheellock gun (figure II-2) is illustrated on magnified scale.

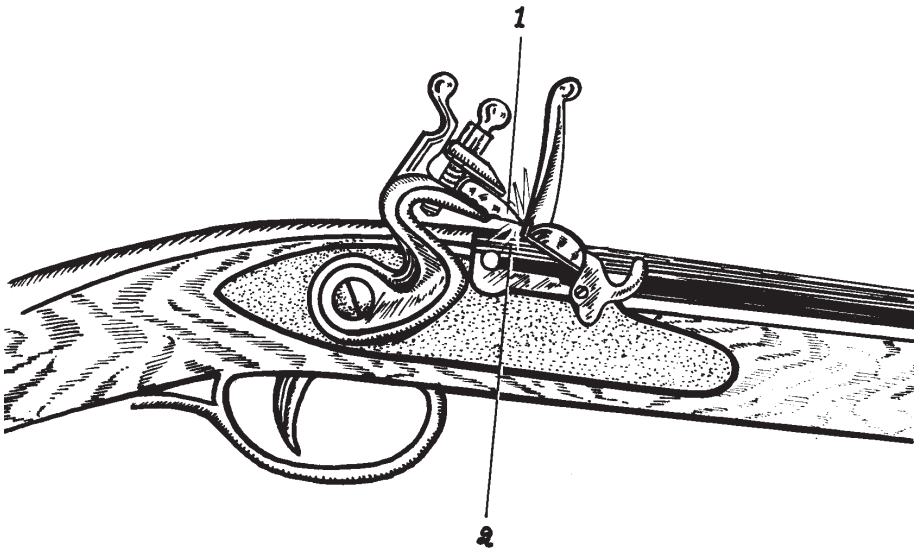


Fig. II-4

Flint Lock Action

On pressing the trigger, flint piece (1) strikes against the flash pan cover and generates sparks which put the powder, in the flash pan below, on fire.

3. MUZZLELOADERS

The important breakthrough in the development of modem firearms was the discovery of a pressure sensitive composition (explosives), which, on being struck, would ignite to give flame. The flame was utilised to set the main powder charge on fire. Originally, the composition was packed in a strip of paper in the form of a pellet. The strip was continuously moved to the touchhole mechanically or by hand to take the sensitive charge pellet to the touchhole. On pressing the trigger, a hammer would fall on the pellet with sufficient force to ignite it. The flame so produced would ignite the powder charge inside the barrel through the touchhole.

The paper pellets soon gave way to percussion caps where the composition was placed in metallic cups. Percussion cap, separately or as part of the complete round, forms an important part of ammunition.

The induction of percussion caps led to the modification of the firearm also. Instead of a touchhole, a nipple was screwed on to the barrel. The percussion cap was placed on the nipple and when struck by the usual trigger-hammer manipulation, the composition gave a flame, which lighted the powder charge in the barrel through the nipple.

This arrangement is the muzzle-loading firearm. Muzzle-loading firearms are met with in some cases even today, in India.

A muzzle-loading firearm has a barrel closed at the stock end and open at the muzzle end. The barrel is fixed to the action and stock and carries nipple on its side near the stock end.

The powder and the projectile charges are loaded through the muzzle. They are separated through paper wads. A ramrod rams them into position to a compact mass. The ramrod is kept handy, placed under the barrel.

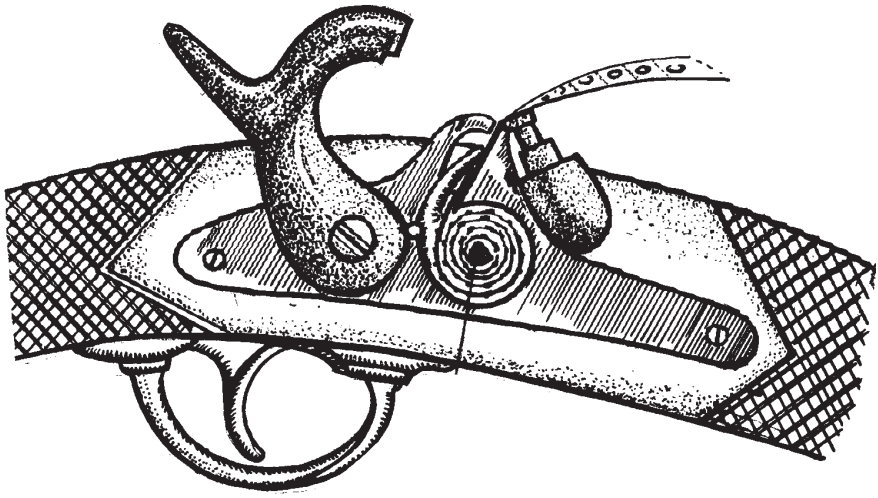


Fig. II-5

The Predecessor of the Muzzle-loading Gun

The action differs from the present day muzzle-loader only in respect of the paper initiation pellet which is fed on to the nipple. On pressing the trigger, the hammer falls on the pellet placed on the nipple. The pellet gives out a flame which puts the powder inside the nipple and the barrel on fire. In the present day muzzle-loading gun a metallic percussion cap is placed on the nipple.

4. MODERN FIREARMS

Modern firearms have been classified in many ways on the basis some prominent characteristics of the firearm. Major classifications are based upon:—

(1) Bore characteristics – smooth bore and rifled bore firearms.

(2) Loading characteristics – muzzleloaders, breechloaders or magazine loaders.

(3) Action characteristics – lever action firearm, bolt action firearms, self-loaders, automatics.

(4) Firing characteristics – single shot firearms, repeaters.

(5) Handling characteristics – handguns, shoulder arms.

(6) Use – sporting firearms, service firearms.

4.1 Shotgun

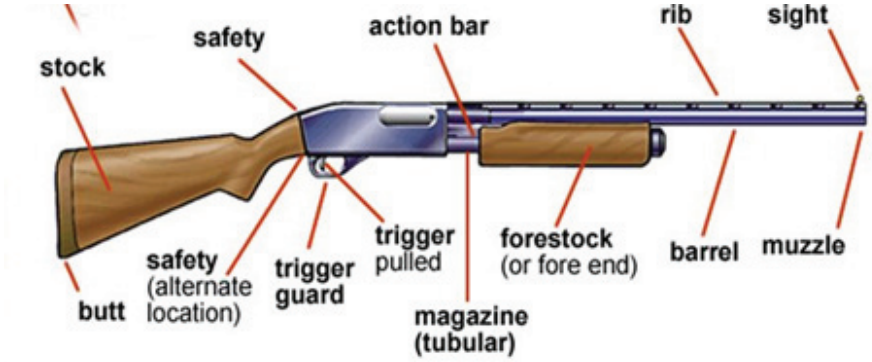


Fig. II-6

Pump action shotgun: popular shotgun with hunters Various parts indicated

The shotgun is an important firearm. The criminals frequently use it in India.

The shotgun family of firearms includes almost all smooth bore firearms. They vary tremendously in their characteristics, from a crudely improvised zip gun *(katta)* to a high-grade repeating gun. Whereas the former can be a highly dangerous device, the latter is safe; even a boy can handle it. Table II-1 below, gives an idea of the variety of the shotgun family.

Table II-1

SHOTGUN FAMILY

(Includes firearm with smooth bore barrel, diameters above 1.25 cm.)

- Muzzle Loading (Getting extinct, use gunpower)
- Breech Loading (Single or double barrelled, popular)
  - Hammered (Cheap. Common)
  - Hammerless (Costly)
    - Side by Side Barrels (Common type)
    - Over and Under (Rare)
    - Shotgun cum Rifle (Rare)
    - Paradox (Partly rifled barrels. Rare)
- Magazine Loading (Popular and common in USA)
  - Self Loading (Use recoil for action)
  - Repeaters (Use manual pump or trombone action for loading and unloading)
  - Bolt Action Cheap and sturdy action)
  - Lever Action

4.2 Parts of a gun

The three important parts of a shotgun are the barrel (or barrels), the action and the stock.

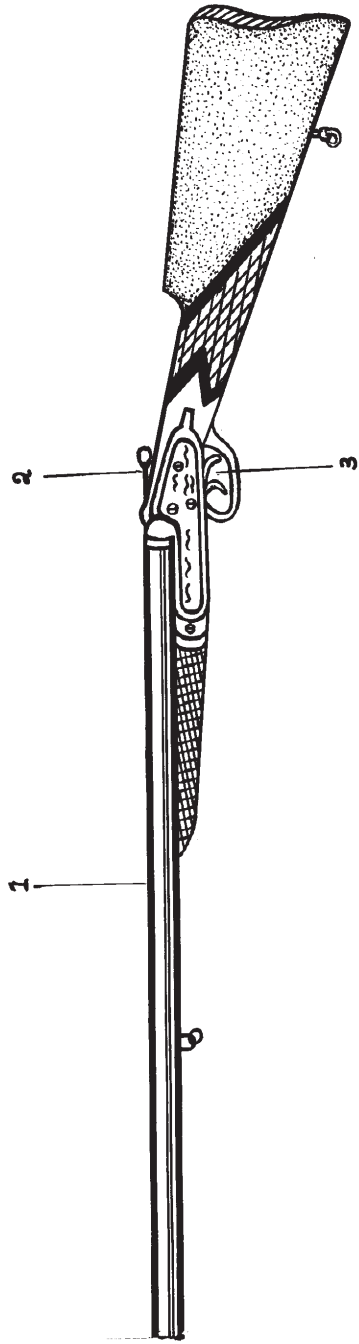


Fig. II-6
Modern Double-barrelled Hammerless Shotgun
(1) barrels, (2) breech lever, (3) triggers.

1. Barrel

A shotgun may have one or two barrels. The barrels may be joined side by side or they may be fixed one over the other. The latter type of gun is an over-and-under shotgun. The side-by-side and single barrel shotguns are more common. 3-barrel guns are very rare. The third barrel is usually rifled and it used to fire bullets.

The barrels of shotguns are ordinarily smooth bore. That is, at any point the bore makes a circle. However, some big game shotguns (*e.g.*, paradox guns); carry two shallow grooves near the muzzle. They give gyratory motion to the single projectiles fired from them. The motion enhances the stability, flattens the trajectory and maintains the velocity better. Thus, the grooves improve the aim and range of the gun. The aim and range are also improved, using special slugs having grooves or fin to give spin to the slug.

The shotgun barrels have varied bore diameters. 12 bore is the common bore but guns with 8, 10, 16 and 20 bore are also met with.

The number prefixed to the bore represents the bore size. A 12 bore shotgun, has internal diameter of the barrel equal to the diameter of a spherical lead ball weighing one-twelfth (1/12) of a pound (454 g.). Likewise, a 16-bore shotgun has diameter equal to a lead ball weighing one-sixteenth (1/16) pound and so on.

The bore size refers to the diameter of the cylindrical barrel or cylindrical portion of the choked barrel.

The bore diameter can be found from the given bore number (or vice versa) from the following formula:

$$d^3 = 4.6578/N$$

Here 'd' = barrel diameter in inches.

'N' = bore number

Table II-2

BORE DIAMETERS OF VARIOUS BORE NUMBERS

Bore number		6	8	10	12	14	16	18	20	24	28	32
Diameter	inches	.919	.835	.775	.729	.693	.662	.637	.615	.579	.550	.526
	cm	2.33	2.12	2.97	1.85	1.76	1.68	1.62	1.56	1.47	1.40	1.34

This rather archaic system of bore nomenclature has been borrowed from the old artillery system, where the guns were designated according to the weight of a lead ball (in pounds), fired from them. Thus, 10 pounder and 20 pounder guns fired balls of the weight respectively.

When the diameter of a smooth bore firearm barrel is less than half an inch (1.25 cm), the bore of the firearm is designated in decimal fractions of an inch. For example, the bore of the musket (a smooth bore firearm) is given in decimal fraction of an inch (.410 inches).

The .410 musket is a prohibited weapon in India. It is a conversion from the .303 rifle. The rifling of the weapon is removed to give it a smooth bore barrel. It fires projectiles of diameter of 10.29 mm. The accuracy range of the weapon is less than 100 metres.

More recently, large bore shotguns have been developed in a number of countries for specialised military or police use. Their bore diameter is given in millimetres, *e.g.,* 37 mm.

Formerly, shotguns had even metre-long barrels. Usually the lengths of the shotgun barrels vary from fifty to ninety centimetres. Now the popular lengths are 65 and 70 centimetres. The long barrel does not offer any advantage with modern ammunition.

Experiments have proved that a barrel of 30 centimetres is adequate for complete combustion of modern powders. The longer barrels confer:

(1) Better stability

(2) Larger sight circle

The use of telescopic and other sights in shotguns have also eliminated the second real or imagined advantage. However, such guns are not common.

Barrel length less than 30 centimetres, however, tends to increase the spread and hence decreases the effectiveness of the shotgun shots.

Table II-3

DBBL SHOTGUN DATA[1]

1. Bore: 12 (.729″/18.5 mm)
2. Barrel length: 30″ or 32″
3. Chamber: 2.5″ or 2.75″
4. Weight: 7.5 pounds approx. for 30″ barrel gun
5. Trigger pull: 5 to 8 pounds
6. Bore:
   a. Right barrel: Cylindrical
   b. Left barrel: Full choke
7. Patterns (in 30″ circle at 40 yards):
   a. Right barrel: 40%
   b. Left barrel: 70 %
8. Muzzle velocity: 1050 f/s

Sawed-off shotguns, with shortened barrels figure frequently in crimes. The short barrel facilitates hiding and portability. Consequently, they are very popular with the criminals.

Improvised 12 bore shotguns/pistols have short barrels. The length often varies from ten to forty centimetres.

The two ends of the barrel of a shotgun are the breech end and the muzzle end. The muzzle end carries a sighting pin at the top, called the foresight. The breech end (also called chamber end) often carries a sighting device, called the rear-sight.

The breech end of barrel(s) is connected to the action through levers, lugs and locks. It has a forearm underneath, to hold the gun.

1. Indian Ordnance Factory gun

2. Choke

Shotgun barrels are often choked. A choke generally is narrowing of bore near the muzzle end, which reduces the diameter of the barrel at muzzle end. The chokes taper inside the barrel to a distance of 3 to 15 centimetres from the muzzle end.

The reduction of the bore diameter (constriction) varies from about 1 to 0.25 millimetres, approximately, in 12 bore shotguns. When the reduction in diameter is one millimetre, it is a full choke barrel. Half millimetre reduction gives half choke. Quarter millimetre reduction provides quarter choke barrels. With lesser reduction, it is an improved cylinder barrel. These dimensions of chokes vary with different manufacturers.

The various types of chokes are:—

1. Standard Choke

In the standard choke, a short length of the barrel, near the muzzle end, has a narrower bore than the rest of the barrel. The change of the diameter is tapered. This is the type of choke used in India and in other countries, which formerly formed part of the British Empire.

2. Cone Choke

In cone-chokes the whole choke length tapers to form the cone. The choke is also called tapered choke.

The cone choke is common in USA. It is sometimes called American choke.

3. Reverse Choke

In a reverse choke barrel, instead of a narrower diameter near the muzzle, the diameter is wider than that of the rest of the barrel.

The spread of the pellet charge is greater in reverse choke barrels than in cylindrical barrels. They are said to give more uniform (even) spreads.

4. Jug Choke

In jug choke barrels, the muzzle end and the main barrel have the same diameter but near the muzzle end (about 2 centimetres from the muzzle, inside) the barrel has a recess, spread over a length of about 15 centimetres. The diameter of the recess is about 2.4 millimetres more than the rest of the barrel. The jug choke barrel gives better and even patterns of the pellets at various ranges.

5. Variable Choke

It is used in pump and other repeater actions shotguns. The following devices are used:—

(1) A convenient number of tubes having different degrees of chokes are carried along with the gun. The tubes and muzzle end of the firearm are threaded that any tube can be screwed on to the muzzle end.

(2) Poly Choke is an ingenious invention. This choke tube is screwed to the muzzle and has a knurled sleeve. When the sleeve is turned in one direction, the fingers of the tube are compressed, decreasing the diameter of the tube. If the sleeve is turned in the other direction, the

compression decreases, the fingers fan out and the diameter increases. Thus, any degree of choke – from reverse choke to full choke – is achieved with the same tube.

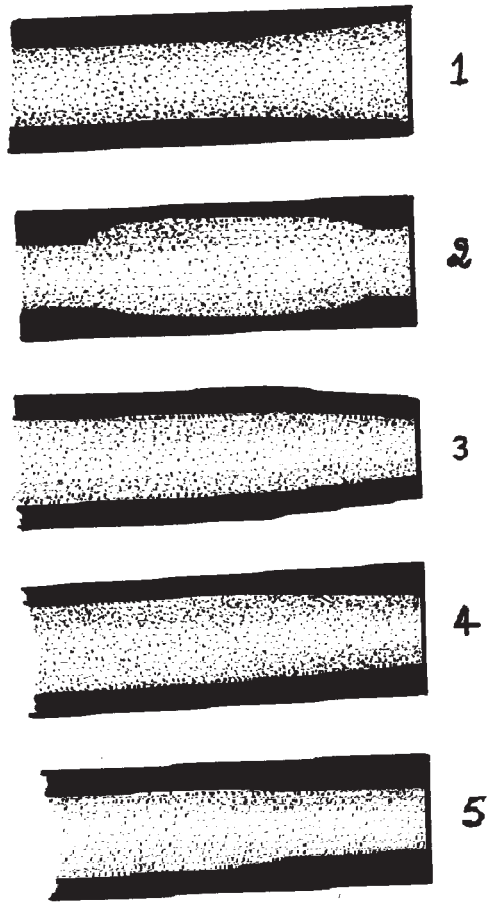


Fig. II-7

Chokes in Shotgun

(1) Reverse choke. It gives wider patterns than a cylindrical barrel. (2) Jug choke. It gives more uniform patterns. (3) and (4) Taper choke. The muzzle bore is narrowed continuously. In (4) the bore is narrowed whereas in (3) the barrel is narrowed. The net effect is the same. (5) Standard choke. This is the type of choke normally used in India and in countries formerly under the British influence.

Chokes have a profound effect on the spread of pellets. Usually it is measured in terms of the number of pellets that hit within a circle of 75 cm (30 inches) at a range of 36 metres (40 yards). An approximate idea about the effectiveness of the chokes can be had from the following table, which is applicable to the shotguns of different bores, though the number of pellets falling in the circle will vary with the number of pellets in the cartridge

Table II-5

EFFECT OF CHOKE ON SPREADS AT 36 METRES

	Chokes	*Pellets % inside 75 cm circle*
1.	Full	70 – 75
2.	Half	60 – 65
3.	Quarter	50 – 55
4.	Improved cylinder	30 – 35
5.	Zero chokes (cylindrical)	20 – 25

The choke effect is also dependent upon the quality of the ammunition, packing of the ingredients of the cartridge and the wad design. The new single piece plastic wad has improved the percentage of pellets hitting the 75 cm circle.

The true cylinders should have zero chokes. In practice, a small constriction is introduced. Usually the diameter is about 0.1 mm less (improved cylinder) at the muzzle end.

3. Chamber

The breech end of the barrel of a shotgun has a special cavity to house the cartridge, called chamber. The diameter of the chamber is slightly more than the diameter of the cartridge, which are fired from the firearm. This extra space is to accommodate expansion of the case, which takes place on firing. The length of the chamber in a 12 bore shotgun varies from about five to eight centimetres depending upon the length of the cartridge to be fired in the shotgun.

The chamber is connected to the bore of the barrel through a tapering called the 'Chamber Cone'. The length of the chamber cone varies from one to five centimetres.

The chamber end carries the extraction and ejection mechanism. It consists of a claw, which is attached to the rim of the chamber. On breaking open the breech, the claw is pushed out of its base. It brings out the cartridge or the case, which was resting on it. The cartridge or case is picked up and removed from the claw.

In ejector shotguns, a mechanism is located in the fore-end. It strikes the extractor cam when the same has brought out the cartridge case from the chamber. The case is flicked out of the extractor. The spring of the mechanism in good quality shotguns is so adjusted, that an unfired cartridge is not thrown out. Double-barrelled shotguns have separate ejectors for the two barrels.

4. Action

The shotguns have varied actions. The common ones are: breech action, lever action, bolt-action, pump action and semi-automatic action.

The simplest shotgun action is made from a block of steel, cut and hammered to a standard functional shape. It has an arrangement to join the barrel on one end and stock on the other end. The action block houses various parts of the action. It is unnecessary to go into technical details of the block. However, the salient features are:—

(1) The barrels rest on flats of the Action Block. The lugs of the barrel fit in the housing in the flats, and are engaged and locked on to the flats.

(2) The breech is opened and locked by a lever. Ordinarily, it is fixed at the top or at the bottom of the action. The lever movements open or lock the barrel with the action-block.

(3) The firing pin is located in the action block. The position of the pin is so adjusted that it is in line with the centre of the base of the cartridge, placed in the chamber of the gun and is in line with the breech face. The firing pin(s) are held inside the action block by springs.

(4) The hammer may be outside or inside (in hammerless guns, it is inside) the action-block. The hammer is held in the cocked position by a sear. When the trigger is pressed, the sear releases the hammer. It strikes the firing pin, which plunges, through the hole in the breech face and strikes the cartridge base at the centre.

(5) There is a trigger guard around the trigger. It prevents accidental pressing of the trigger to cause accidents.

(6) Each barrel firing pin has a separate firing mechanism. In some costly shotguns, however, there may be only one trigger to fire the two barrels, one after the other, by consecutive pulls on the same trigger.

Bolt actions (common in rifles) and pump actions are also used in shotguns. The working of the bolt action is similar to the one used in rifles.

The pump action is also called trombone action. Pump action shotguns are called pump action shotguns or repeaters. They are popular in United States of America for their increased firepower. Besides, they are cost effective *vis-à-vis* high-grade double-barrelled shotguns.

The pump action is simple in principle. There is a sliding fore-end. When the fore-end is pushed towards the stock, it actuates a cam. In its backward movement, it extracts and ejects the fired cartridge. On return journey, it picks up a cartridge from the magazine, loads it in the chamber and closes the breech. Simultaneously, it cocks the hammer. The firearm is ready for firing.

The cartridges are housed in a cavity in the fore-end. A spring keeps the cartridges pressed towards the chamber end.

Self-loading action in repeater shotguns is obtained either from the expansion of gases or from the recoil of the fired cartridge cases.

The gas-operated semi-automatic action is similar to a hand-operated pump action and the usual semi-automatic action. The functioning of the various parts is like a pump action repeater gun.

In recoil-operated repeaters, the expanding gases move the cartridge case backward (2 to 3 millimetres). The force is transferred to an inertia rod, which is pushed backwards, taking along with it the fired cartridge case (and throws it out) and the firing mechanism assembly. When the recoil energy is exhausted, the compressed spring takes over and pushes the assembly forward. On its forward journey, it places a live cartridge in the chamber, closes the breech and cocks the firearm. It is ready for fire.

5. Stock

The stock of a shotgun is a wooden piece joined to the action-block. The proper construction of the stock has great influence upon aim and comfort in handling the firearm.

6. Fore-end

The fore-end is a wooden and steel piece fitted to a shotgun underneath the barrel(s) and adjacent to the action block. It facilitates holding the gun in the firing position, opening the gun for unloading and loading. It helps in ejection and cocking of the firearm in some shotguns. In semi-automatic and pump action shotguns, it houses the repeater mechanism.

The fore-end has limited forensic importance. It may indicate the serial number of the firearm or some operational defect to account for accidental going off the weapons.

In a murder case, an improvised shotgun was used. The fore-end of the firearm fell at the scene accidentally. Later when the gun was recovered from the suspect, it was possible to indicate that the fore-end originally formed part of the gun. It not only fitted snugly to the gun, but the fore-end also carried scratch marks which could be attributed to the corresponding part of the gun coming in contact with the fore-end. (CH)

5. RIFLES

Rifles are usually identified by their calibers, measured across the lands (uncut portions of the rifled barrel). They are described in thousandth parts of an inch, hundredth parts of an inch or in millimetres. The designated calibres are nominal only. Often the actual diameters do not correspond to the designated calibres.

The rifle, like a shotgun, has a barrel, an action and a stock. In addition, it has often a magazine. The barrel and action differ significantly from corresponding parts in shotguns.

5.1 Barrel

The following information about a rifled barrel is noteworthy:

1. Lands and Grooves

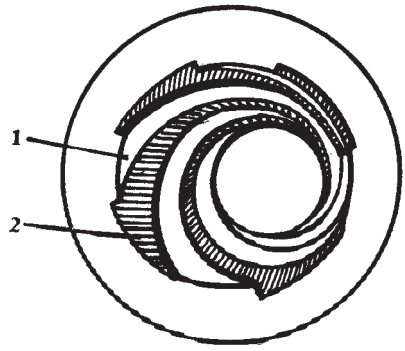


Fig. II-8(i)

A look through a rifled barrel shows lands (1) and groves (2).

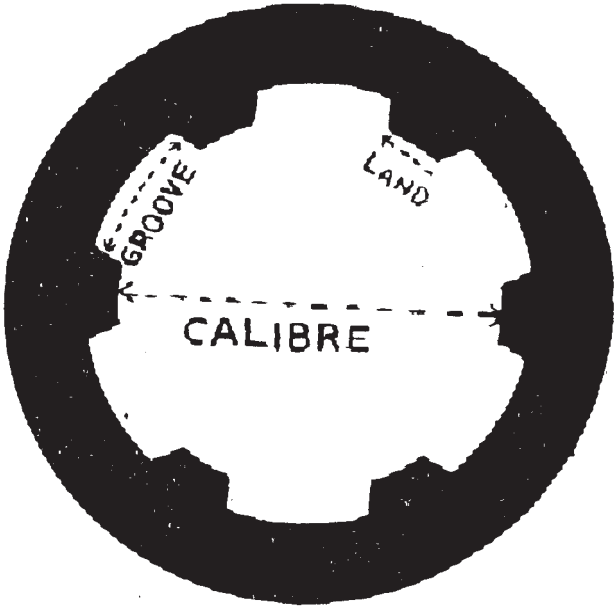


Fig. II-8(ii)

Cross-sectional view of a rifled barrel

The rifle barrels have canal like furrows, called grooves. The furrows are cut in spiral forms inside the bore. The uncut surfaces between the grooves are called lands. The number of the grooves in a rifle varies from two to twenty-two.

The number of grooves affects the stability of the bullet. However, a clear relationship between the number of grooves and the stability has not been established. Firearms with four grooves and upwards have been found to give satisfactory results. The rifle with 16 shallow grooves is also found satisfactory. The width of the grooves and lands may be, or may not be the same in a firearm. The depth of the grooves varies with different manufacturers.

Grooves are cut in the barrels in many ways. The following ones are common:—

(1) A single-edged cutter is used repeatedly until the desired depth is achieved in a groove.

(2) A double-edged cutter is used in the same way. Two grooves are cut simultaneously.

(3) A gang of broaches is used. The device is a steel rod having rings of hardened steel. The rings have cutters, equal to the numbers of grooves to be created in the barrel. These rings have increasing diameters, each slightly larger than the one ahead. Each of them gives a deeper cut than the forward ring. Their number is so adjusted that the last one cuts the groove to the desired depth. Thus, grooves are created in one operation.

(4) A mandrel of reverse impression of rifling is forced through the barrel of larger diameter and the latter is hammered. The grooves are imprinted in the barrel. Rifling so produced has a typical appearance and is also known as polygonal rifling.

(5) Heated carbide buttons 'print' the grooves inside the barrel.

(6) Electrical machining is a new technique to create rifling in barrel. There are two modes:

   a. Electrical discharge machining (EDM), and

   b. Electro Chemical Machining (ECM)

These methods erode bore metal from the groove sites. They create uniform diameter and smooth finish in the barrel bore.

EDM method is costly and primarily used in large bore, long barrel like that of cannon. Some smaller barrel makers use ECM method.

The spiral form of grooves is obtained by turning the cutter while cutting the groove. The turning of the cutter may be clock-wise or anti-clock-wise. This turning brings in twist in the spirals. The angle of the turning is the pitch of the groove. The angle is often described in calibre/lengths or in terms of the length in which one turn is completed. For example, in the .303 service rifle the pitch is one turn in 10". In the 7.62 mm service rifle, it is one turn in 30.5 cm. The twist is responsible for the spin, which serves to stabilize gyroscopically the projectile, improving its aerodynamic stability and accuracy.

The weight, shape, length and velocity of the bullet and the barrel's length and bore size of the firearm determine the angle of the twist for the firearm. Higher the velocity, greater is the angle of the twist. Otherwise, the projectile wobbles and may not strike the target in the nose-on position.

The invention of grooves (rifling) in firearm was a great step forward in the improvement and development of firearms. It increased the range and the accuracy of the aim greatly.

The rifling gives gyratory motion to the projectile, which continues even after the projectile has left the muzzle of the firearm. The gyratory motion (spinning) has two important effects on the bullet:—

(1) It stabilises the bullet flight with nose-on position.

(2) It decreases the air resistance.

The stability is due to its spin around its longitudinal axis. It prevents turning of the bullet sideways and thus, greater stability.

The decrease in air resistance to the bullet in flight is because unlike non-rotating bullets, a rotating bullet does not develop increasing denser mass of air, continuously. Instead, the spinning motion scatters the air in front throughout its passage.

The decrease in air resistance has two important effects. The fall in velocity is comparatively less over a given distance. Consequently, the fall in striking velocities is minimal. Secondly, the trajectories (path of the bullet flight) are

flatter. Thus, better aims and effective striking velocity remains over longer ranges.

Rifling increases the aiming range of a firearm from about a hundred metres to several hundred metres. In fact, British troops carried out firing practice with earlier rifles at a range of about 900 metres. The range was later reduced to about 500 metres. Now the general feeling of the defence authorities all over the world is that it is futile to train military men to fire at ranges beyond 400 metres. Rifling also increased the killing range of the firearms tremendously. A .303 rifle was the service rifle in India for most of the 20th century. It is still encountered in criminal cases. It can kill a person even at a range of three kilometres!

2. Barrel Calibre

Rifling has reduced the weights and diameters of the service projectiles drastically. The spinning and high velocities could cause destructive wounds even with small calibre projectiles. The large calibre (bore) firearms became redundant, especially for military use. Now there is no military rifle having a diameter greater than 7.62 mm, whereas formerly there was none with a smaller calibre. The calibre of the service rifles has come down still further, in recent years. Most of the service rifles now fire only 5.56 mm bullets or of lesser diameter. Some big game rifles continue to have larger calibres.

3. Barrel Length

The barrel lengths are usually thirty to seventy centimetres. It has been observed that longer barrels give slightly better muzzle velocities. However, the increase is only marginal; for example, about 5 percent increase of velocity was observed for .30–06 ammunition, when barrel length was increased from 50 to 80 centimetres.

4. Conversion Barrel/Barrel Inserts

In some firearms, the same action and stock can be used with barrels of different calibres. Thus, hunters can use an appropriate barrel calibre for different game. For example, 6.25 mm calibre may be suitable for fowl hunting; 7.5 mm calibre may be suitable for the wild goat while 15 mm calibre may be found suitable for big game. With the same lock and stock, but with different barrels, the function of three firearms could be performed conveniently. Some large calibre barrels take tube inserts. They reduce the calibre and ammunition of lower calibre can be fired.

5.2 Action

Different actions like lever action, bolt action, slide action, semi-automatic, automatic action and breech loading action are used in rifles.

1. Lever Action

In lever action rifles, ordinarily, lever is fixed below the trigger. It also acts as trigger guard. When it is manipulated, it extracts the fired cartridge and cocks the rifle. Simultaneously the carrier block is pushed upward which carries along a live cartridge. When the lever is brought to its normal position, the rod places the live cartridge in the chamber and the carrier block moves to its original position. The rifle is ready for fire.

2. Bolt Action

The bolt action is used in .303 rifles. Loading and unloading operations are carried out through a strong steel bolt with a knob. In the forward normal position, the bolt is locked with its knob turned to one side. In this position, it seals the chamber also. The firearm is cocked in this position unless it has already been fired. The firing pin assembly is inside the bolt. When the trigger is pressed, the firing pin flies forward through a hole in the bolt head and strikes the cartridge.

The bolt head is fitted with an extractor. When the bolt is drawn backward, the fired cartridge case is also extracted from the chamber and trails along with the bolt. When the bolt reaches a position, where the cartridge in line with ejection hole it strikes against an ejector device with sufficient force and is thrown out.

When the bolt is pushed forward, it picks up a cartridge from the magazine and places it in the chamber of the firearm. The forward motion also locks the weapon. Turning the bolt knob to one side seals the chamber along with the cartridge and the firearm is ready for firing.

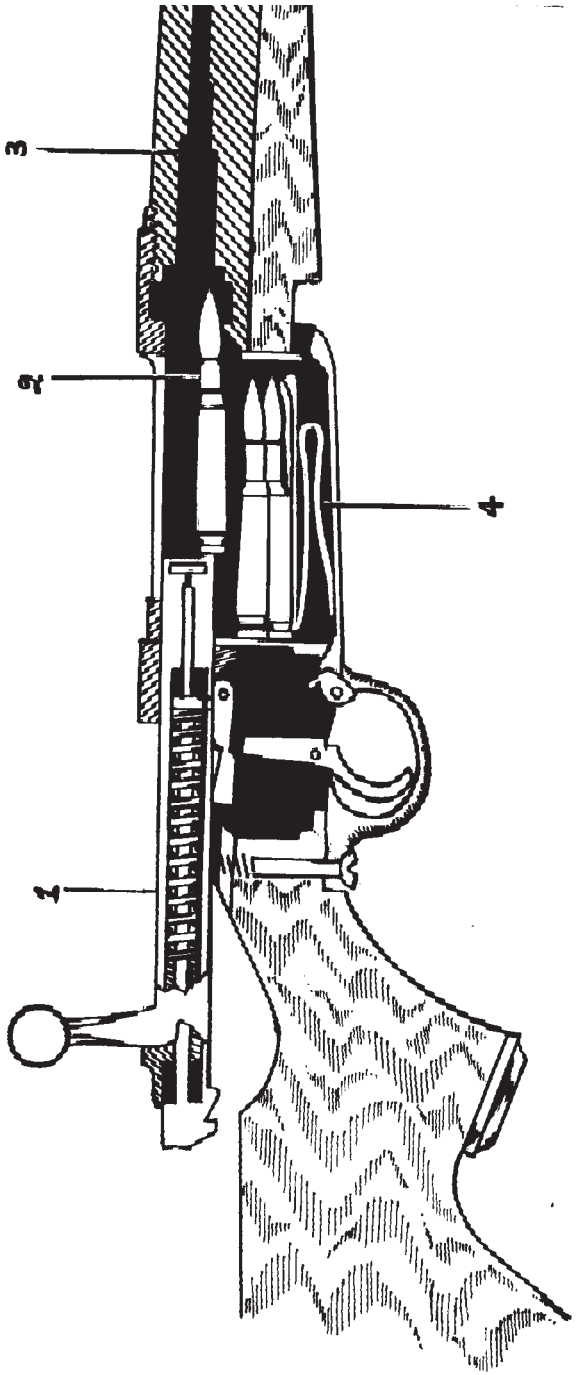


Fig. II-9

Bolt Action of a Rifle

The inside parts of the bolt are indicated in the sectioned bolt (1). Cartridge (2) is being carried to its chamber (3) by the bolt assembly. (4) Spring of the magazine keeps the cartridge pressed upward.

3. Slide Action

The slide action is also known as 'trombone' action or pump action. It is similar to the one used in shotguns.

4. Semi-automatic Action

The semi-automatic action, due to increased ease and speed of firing, became a favourite action in service rifles of most of the nations in the latter half of the 20th century.

In this action, if the trigger is pressed when the firearm is loaded and cocked, it fires the cartridge. In addition, the energy of the firing process is utilised to extract and eject the empty case, load a new cartridge in the chamber and cock the firearm for a second fire.

The semi-automatic action is operated either through recoil produced in the empty shell, by the outgoing ejecta or by utilising a part of the expanding gases in various ways:—

1. *Simple blowback action:* In this action, the breechblock is unlocked. It is pushed backward by the cartridge case but the breech opens only when the bullet has left the barrel. The action can be used only in low-powered cartridge-rifle combinations, as in .22 rifles, sub-machine guns and in some self-loading pistols.
2. *Retarded blow back action:* The movement of the breechblock is achieved through a toggle, which retards the opening of the breech. It is used in machine guns.
3. *Short or long recoil action:* In these actions, the barrel is locked to the breechblock and they move rearward together to a certain distance before being disengaged. The other operations are carried out as in other types of semi-automatic action by the disengaged breechblock.

The action is employed in both rifles and pistols.

In gas-operated actions, the firearm has a hole in the barrel at a suitable distance from the muzzle end. Some convenient, predetermined, volume of gas escapes through the hole and operates a piston. This piston actuates a rod, which pushes the breechblock backward. Simultaneously, in its backward journey, it extracts the fired shell. The shell strikes against an ejector placed at a suitable position. The shell is thrown out. On its return journey (due to the action of a spring), the breechblock picks up a live cartridge from the magazine and placed in the chamber. The chamber is sealed by the breechblock after it is locked, automatically.

The gas operated semi-automatic action became more or less the standard action in military firearms in place of the bolt action in the latter half of the 20^{th} century.

5.3 Magazine

Magazines are used in repeating automatic and semi-automatic firearms. They are aligned with the chambers of the barrel on one hand and with the moving bolt or breechblock on the other hand. In some firearms, the magazine is permanently fixed; in others, it may be detachable. Both arrangements have

the same working principle. There is a spring attached to the bottom of the magazine. This spring fills up the whole box even when the magazine is empty. When cartridges are filled in it, they continuously depress down the spring until the magazine is full.

In the normal locked condition, the magazine of rifle remains compressed under the moving block. It is released when the moving block is drawn backward. When the block comes forward, it picks up a cartridge from the magazine and carries it to the chamber. The rest of the cartridges remain compressed under the block assembly. The process is repeated each time when the moving block moves backward and forward.

5.4 Stock

The stock of a rifle functions like a shotgun stock. Structurally it is an elongated stock combining fore-end and the stock in a single wooden piece. In modern rifles, stocks of plastic materials are being adopted. In some rifles, even a skeleton steel structure is used in place of a stock.

6. INDIAN RIFLES

6.1 .303 Rifle

The .303 rifle has been with the armed forces for a long time. It is only in the past few decades that this rifle has been replaced in the army. They are still in use in the country but not by the military forces. However, there are a large number of these rifles with the criminals in India.

Table II-6

.303 RIFLE DATA

1. Calibre: .303″
2. Over-all length: 44.5″
3. Weight: 8 lbs. 10.5 oz
4. Action: Turn bolt
5. Magazine capacity: 10 rounds
6. Barrel length: 25.2″
7. Bore diameter: .303″ (nominal)
8. Groove diameter: 312″
9. Depth of grooves: 0.065″
10. Width of grooves: 0.0936″
11. Number of grooves: 5
12. Pitch: 1 turn in 10″
13. Direction of twist: left
14. Rate of fire: 15 to 20 rounds/min.

6.2 Currently used rifles in India are:—

The armed forces in India are using a variety of rifles. In addition, Russian Assault rifle AK 47 and rifle AK 74 (especially AK 47), are also available in

large numbers smuggled into the country by the terrorists. Some of the common ones are:

1. 7.62 Self-loading Rifle

This semi-automatic rifle is the service rifle of the Indian armed forces. It is also on its way out. It is being replaced by INSAS 5.56 rifle to conform to the standard NATO pattern. The particulars of the 7.62 rifle are given in the Table II-7:

Table II-7

7.62 RIFLE DATA

1. Calibre: 7.62 mm
2. Length of the rifle: 1140 mm
3. Length of the barrel: 535 mm
4. Number of grooves: 6
5. Pitch of rifling: 1 turn in 305 mm
6. Direction of rifling: Right hand
7. Weight of rifle only: 4.4 kg
8. Weight with full magazine: 5.1 kg
9. Effective rate of fire: 60 rounds per minute.
10. System of operation: Gas
11. Sight radius: 555 mm
12. Magazine: Box type
13. Magazine capacity: 20 rounds
14. Max. Effective range: 600 metres

2. INSAS 5.56 Service Rifle[1]

INSAS (Infantry Small Arms System) service rifle is a recent product of Indian Ordnance Factories. It conforms to the rifles used by the NATO countries. The ammunition used in those rifles can be used in all the INSAS weapons system. It has incorporated a number of feature from AK 47 The various specifications of 5.56 rifles are given below:

Table II-8

5.56 RIFLE DATA

1. Length: Fixed butt, 945 mm. Folded butt, 750 mm.
2. Weight without magazine: 3.2 Kg
3. Barrel length: 464 mm
4. Rifling: 6 grooves, RH twist, and one turn in 200 mm
5. Operation: gas operated. On selection a burst of 3 shots can be fired
6. Locking: Rotating bolt

1. The replacement of the rifle is under active consideration of the government.

7. Magazine: Plastic box with 20 or 30 capacity
8. Cartridge: 5.56 x 45 mm
9. Rate of fire: 650 rounds per minute.
10. Muzzle velocity: 915 m/s
11. Maximum effective range: 400 m

The standard rifle can be fitted with night vision deviceS or optical sight. It has arrangements to equip it with flash eliminator, bayonet or grenade launcher.

A carbine or short assault rifle version of the rifle has also been designed.

A comparative view of the details about the various service rifles of some of the countries are given below:

Table II-9

Country	*Rifle*	*Calibre (mm)*	*Barrel (mm)*	*Weight (Kg.)*	*Magazine (Capacity)*	*Fire rate (per min.)*
India	INSAS	5.56	464 mm	3.2	20/30	650
Russia	AK 74	5.45	400 mm	3.6	40	650
Israel	Galil	5.56	524 mm	4	35	650
Germany	G 11	5.56	518 mm	3.72	20	800
Swiss	SIG 541	4.7	540 mm	4.26	50	600
British	Enfield	5.56	357 mm	3.34	20	—
France	FAMAS	5.56	488 mm	3.94	25	950

The service rifles are part of the weapon system of a country firing ammunition of the same calibre. The other members of the system are, assault rifles with or without modifications, Light Machine Guns and Machine Guns.

6.3 Service Rifles

Assault rifle is the name given to modified service rifle by Hitler in World War II. It is a logical change from the traditional heavy rifle. In assault rifles the same ammunition as used in rifles is used. They are compact and convenient in combat situations. They can be used both as semi-automatic or automatic weapons.

The following reasons have prompted the change to assault rifles:—

1. The opposing soldiers shooting each other are at short distances, sometimes in trenches, which may be less than 100 metres apart.
2. The normal visual range in normal light to spot an enemy is seldom more than 400 metres. It is futile to have weapons which are lethal at 2000 metres. Instead, the weapon with lethal range up to 500 metres should be sufficient.
3. The reduction in weight of arm and ammunition is advantageous:—
   a. Less fatigue.
   b. More ammunition, more power.
   c. Night sight etc. can be added.

This logic has prevailed upon the concerned persons in all countries. There was initially reduction of the calibre of the weapon to 7— 8 mm. It has further gone down and the favoured calibre today is 5.6 mm, though the most revolutionary rifle of recent times, uses only 4.7mm calibre. All countries have light-machine guns, machine guns.

Some details about some of the assault rifles are given below:—

1. Kalashnikov AK 47

Assault rifles are often modified versions of service rifles. They have become very popular with the terrorists in our country and elsewhere. The Russian Assault rifles, AK 47 (calibre 7.62 mm), of Russian design, though manufactured in various modified forms all over the world, are being used extensively by the terrorists. It is their special favourite and is so widely misused by them in India that the rifle is associated with the terrorists by the common man.

Specifications of assault rifle (AK 47*)*.

Table II-10

1. Length: 699 mm (butt folded), 869 mm (butt extended)
2. Weight with telescopic sight: 4.3 Kg.
3. Barrel length: 414 mm
4. Rifling: 4 grooves, RH, one turn in 235 mm.
5. Operation: gas operated.
6. Locking: Rotating bolt
7. Magazine: Plastic box, capacity 30 rounds
8. Cartridge: 7.62 x 39 mm
9. Rate of fire: 600 rounds/minute.
10. Muzzle velocity 710 m/s.
11. Maximum effective range: 300 m.

It is fitted with a muzzle brake (compensator) to divert gases to the sides and upward. The device reduces the recoil and upward jump during automatic fire. The device reduces the recoil to negligible limits. The shooter feels very little fatigue.

The bullets have mild steel core with some lead. They are fully jacketted; the top has a hollow point.

The assault rifles are not more powerful than the service rifles but they are more effective at the ranges involved in assaults. The maneuverability, the surety of the kill (mild steel core, hollow point), and the lesser recoil are the reasons which have endeared them to the terrorists in India.

2. Kalashnikov AK 74

This weapon was developed as the new assault rifle in Russia and is an extensively modified version of the former assault rifle AK 47.

The earlier weapon (AK 47) had 7.62 mm calibre having a cartridge case length of 39 mm. The calibre has been reduced to 5.45 mm in AK 74. The bullet

is fully jacketted. It has mainly a mild steel core, though with a lead tip at the top of the steel core. The top jacket tip is hollow. This structure of the cartridge has made it highly lethal. The tip is crushed on hitting the target, increasing the cross sectional area and transferring more energy, which causes severe wounds.

Table II-11

AK 74 RIFLES

1. Length: 930 mm (butt unfolded), 690 mm (butt folded)
2. Weight (unloaded): 3.6 K.
3. Barrel length: 400 mm
4. Rifling: 4 grooves, RH twist, and one turn in 196 mm
5. Operation: gas operated. On selection one can fire in bursts of 3 shots
6. Locking: Rotating bolt
7. Magazine: Plastic box; capacity 30 rounds
8. Cartridge: 5.56 x 39 mm
9. Rate of fire: 650 rounds/minute. (cyclic)
10. Muzzle velocity: 900 m/s
11. Maximum effective range: 400 m

It is fitted with a muzzle brake (compensator) to divert gases to the sides and upward. The device reduces the recoil and upward jump during automatic fire. The device reduces the recoil to negligible limits and the shooter does not feel the fatigue.

3. G11: German Rifle

This rifle uses a caseless cartridge and has tremendous rate of fire – it can fire 2000 shots per minute. The use of caseless cartridges in the rifle is a tremendous advance in the development of ammunition (and arms). It has very high accuracy. In a burst of 3 shots, the bullets, at 300 metres, zeroed within a distance of 2.5 cm to one another. Thus, not only it eliminates the dead weight of the shells, which the soldiers have to carry with them, but also gives them higher fire power and higher accuracy.

The caseless ammunition is revolutionary in the nature of the propellant also. It is RDX - based. It is a beacon light to other manufacturers of arms and ammunition. The advent bids for complete overhaul of the arms-ammunition manufacture the world over. The cost factor and technology hurdles, however, may delay its adoption.

4. INSAS 5.56 Assault Rifle

INSAS (Infantry Small Arms System) 5.56 assault rifle has been developed in India. It has incorporated many useful features from other firearms especially from AK - 47.

6.4 Assault Shotguns

Standard service rifles cannot be useful in close range fighting, especially in riot cases. There was, therefore, a need for the development of a weapon, which

could be effective to control riots and in close assaults in military operations. Such a weapon was termed CAWS (Close Assault Weapon System). It is more or less a 12 bore modified shotgun with modified ammunition.

The main features of the system are:—

1. The weapon is a repeater with fire capability of 10 to 20 shots.
2. The cartridge is capable to incapacitate a person at a range of 100 metres.
3. A cartridge fires has 20 flechettes, each weighing about 3.5 grams.
4. It can fire pellets made of harder material [depleted uranium (DU); tungsten]. They have also been used cartridges of pellets with higher velocities.
5. Additionally, the cartridge can contain and carry to the target: Chili powder, explosives, incendiary, lachrymatory or anti-armour material.

In England, Enfield has developed a 37 mm anti-riot weapon and its ammunition. It fires plastic projectiles and lachrymatory gas pellets. At present it is a single shot weapon. But there are proposals to make it a multi-shot weapon also. It is also being considered to graduate it to an infantry support weapon after modifications of its charge to combat-loading, containing explosives, smoke, illuminating and anti-armour materials. The weapon has been given the name ARWEN (acronym for Anti-Riot Weapon, Enfield).

6.5 Indian Modern Sub Machine Carbine

The Modern Sub Machine Carbine (MSMC) is a gun designed by the Armament Research and Development Establishment. It has the following specifications:

1. Caliber: 5.56 mm
2. Rate of fire: 700–900 RPM
3. Effective firing range: 200–300 m
4. Manufacturer: Indian Ordnance Bureau

For all practical purposes, carbines are rifles with shortened barrels. Ordinarily, the carbine barrels are about fifty centimetres in length.

Carbines were introduced for cavalrymen who fought while riding on horses. The firearm could be handled better while mounted on a horse. Now carbines have become side firearms for the fighting forces of some countries.

Modern carbines are semi-automatic weapons, which can be turned to automatic action. Assault rifles are superseding them.

7. REVOLVERS

A revolver is a convenient, sturdy and repeater rifled handgun. It has a unique construction among the firearms in having a revolving wheel for a magazine. The wheel is often called a cylinder. The cylinder has a number of chambers, varying from four to seven, in which live cartridges are loaded. The chambers are positioned carefully *vis-à-vis* the movement of the cylinder

(synchronised). On pressing the trigger the next chamber gets aligned with the barrel of the firearm.

A revolver, like other firearms, has varied calibres – varying from 3 mm to about 15 mm. The most common number of chambers is six. The sizes of revolvers also vary tremendously, varying from pocket models to handguns so heavy that they are difficult to manage with one hand.

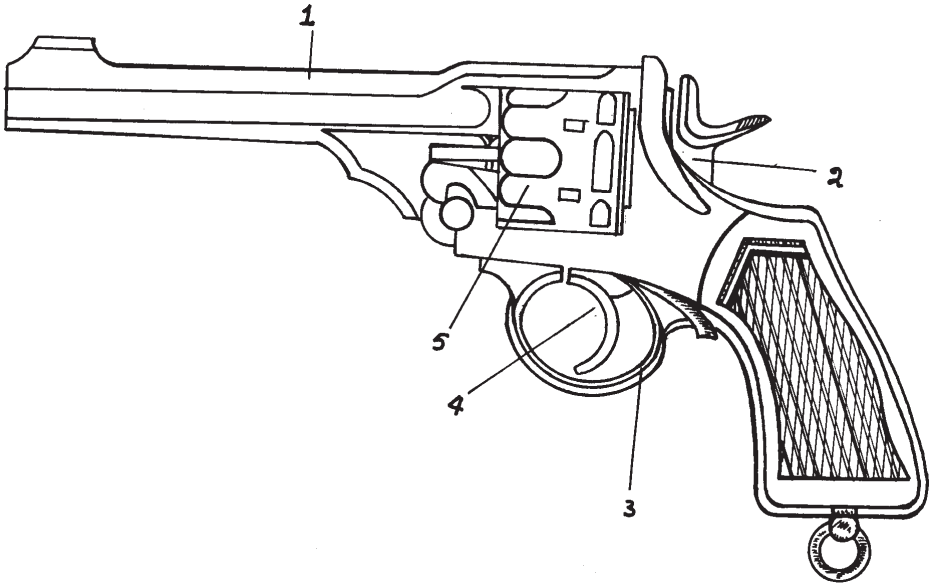


Fig. II-10

A typical break-open revolver with barrel (1), hammer (2), trigger guard (3), trigger (4), and the revolving wheel (5).

A revolver, especially a double action revolver, is not very accurate in aim. It is mainly due to the heavy trigger pull and jump. Consequently, a revolver is used as a personal weapon for short range firing only. It was the commonest side arm of the fighting forces. Semi-automatic pistols are now replacing it. It is, however a popular weapon in USA.

Table II-12

THE INDIAN SERVICE .38 REVOLVER (No. 2, MK 1)

1.	Overall length	= 10.25″
2.	Barrel length	= 5 ″
3.	Capacity	= 6
4.	Calibre	= H (.354 inch), L (.352 inch)
5	No. of grooves	= Seven
6.	Pitch of rifling	= One turning in 15″
7.	Direction of rifling	= Right-handed.

7.1 Parts of Revolvers

The following parts of a evolver are of forensic significance:

1. Barrel

The barrels of revolvers, like those of rifles, have two to seven grooves. Likewise, the widths, depths and angles of twist of the grooves vary tremendously with different manufacturers. The barrel lengths vary from 5 to 30 centimetres.

The revolver barrels are unique in one respect. They have no chamber and there is always some space between the barrel and the chamber in the revolving cylinder. This gap is sometimes responsible for the shaving of the bullets, when the chamber is not perfectly aligned with the barrel. The shaving can help in the identification of a fired bullet in respect of the firearm.

The gap is also responsible for leakage of gases and powder residues. The residues deposited on the hand of the shooter, permit identification of the hand that fired the shot. The leakage of gases through the space however, has no substantial effect on the ballistics of the projectile.

2. Action

The action of a revolver is unique. When the trigger of a double action revolver is pressed, it rotates the cylinder containing the cartridges. The cylinder revolves through an angle to bring the next chamber of the wheel in alignment with the barrel and the firing pin hole. The rotation of the cylinder is achieved by having a small cog (projection) on the hammer lever which gets engaged to a tooth of a ratchet (with a number of teeth depending upon the number of chambers in the cylinder) cut on the head of the cylinder. When the cylinder has moved through the required angle, the cog and the ratchet get disengaged and the hammer gets cocked and soon after gets released. It strikes the percussion cap on the base of the cartridge and fires it. The bullet, which is already resting near the chamber end of the barrel, gets into the barrel and moves towards the target after acquiring forward and rotatory motions.

In single action revolvers, the hammer is cocked manually each time before firing. In the process the cog and ratchet arrangement rotates the cylinder to bring the next chamber with a live cartridge in alignment with the barrel and the firing pin hole.

Loading and unloading of revolvers are carried out in different ways. There are mainly three types of mechanisms for the purpose.

3. Solid Frame Revolvers

The solid frame revolver has a port (gate) on the right side. It is large enough to load or unload all the chambers, one by one, through this exposed port. Unloading is facilitated with an ejector rod. For loading and unloading, the revolver is half cocked, which permits rotation of the cylinder. Turning brings a chamber to the loading/unloading position. After one chamber is loaded/unloaded, the second chamber is aligned with the port by rotating the cylinder. This process is repeated till all the chambers are done with.

4. Break Frame Revolvers

A break frame revolver has a latch. It holds the stock and the barrel parts of the revolver together. On sliding the latch, the revolver opens like a shotgun. It exposes the chambers in the cylinder. If the revolver is to be emptied of fired or live cartridges, it can be done individually or collectively by tilting the revolver. In some revolvers the cartridges (live or fired) are raised by an extraction mechanism. A break frame revolver is also called *'Tip Up', 'Hinged Frame'* or *'Top Break'* revolver. They are dangerous with powerful cartridges, though quite popular in .22 calibre.

5. Side Swinger Revolvers

In side swinger revolvers the wheel is joined to the solid frame through a latch, usually on the left side, to which side the cylinder swings out on pushing, exposing the chambers.

The chambers are loaded one by one manually. For unloading the rod fixed in front of the cylinder is pressed. It ejects the cartridge cases. They are also known as *'Swing Out'* or *'Side Ejection'* revolvers. Side swinger revolvers are the most common revolvers in U.S.A.

Fig. II-11

4 Barrel Pistol

8. PISTOL

The pistol started its life from very early days of firearms – from the matchlock and flintlock era. The pistols in olden days were firearms with shortened barrels up to 40 centimetres. Originally, they were single shot pistols only but soon after multi-shot pistols also appeared. They had two or more barrels, which could be fired in turn. These multi-barrel pistols are known as Derringers in U.S.A.

Pistols have been always popular because of their many advantages.

Fig. II-12(1)

Auto 9 mm: Side arm of Indian forces

Fig. II12(2)

UZI: Israel's famous pistol; concealable, lightweight, high rate of fire side arm of world's most armed forces

Pistol is a general name for short-barrelled firearms. Strictly speaking, even revolvers fall under the category. Now, however, the name of pistol is coming to refer to a firearm, which is ordinarily a semi-automatic rifled handgun. Some manufacturers make fully automatic pistols, which can also act as semi-automatic firearms.

The pistol is a favourite firearm with many, because of its size, graceful shape, convenience of handling and quick and more firepower.

Single shot pistols are still used as target pistols. They are not common in India or in crime situations. However, improvised single-shot pistols, of different calibres, are frequently encountered. Mainly they fire 12 bore cartridges. Sometime such pistols, for .303 ammunition, are also encountered. Improvised pistols for other calibre ammunition are rare.

8.1 Parts of a pistol

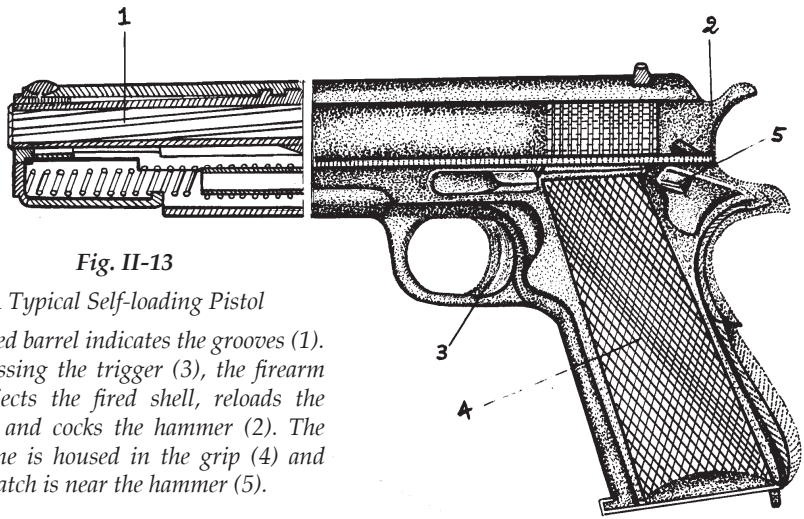


Fig. II-13

A Typical Self-loading Pistol

Sectioned barrel indicates the grooves (1). On pressing the trigger (3), the firearm fires, ejects the fired shell, reloads the firearm and cocks the hammer (2). The magazine is housed in the grip (4) and safety catch is near the hammer (5).

A pistol has the usual important parts: action, barrel and magazine.

1. Action

The action of a small semi-automatic pistol is, ordinarily, based upon the blowback principle. When a cartridge is fired, the gases so produced exert pressure in all directions. The bullet is projected forward through the barrel while the cartridge case is pushed backward. The cartridge case, in its backward motion, pushes the breechblock backwards. The breechblock is comparatively heavy and is pressed in position by a spring. The weight of the block and the strength of the spring are so adjusted that the cartridge case comes out of the chamber only after the bullet has left the barrel. The backward motion of the block and the cartridge case continues till the backward force is spent. In the meantime the ejector pushes out the fired cartridge case and the block crosses beyond the magazine. The breechblock now retraces its path, that is, it moves forward. In its forward motion the block picks up a live cartridge from the magazine and places it in the chamber. The pistol is ready for a second fire. The pressure on the trigger repeats the performance each time till all the cartridges in the magazine have been fired.

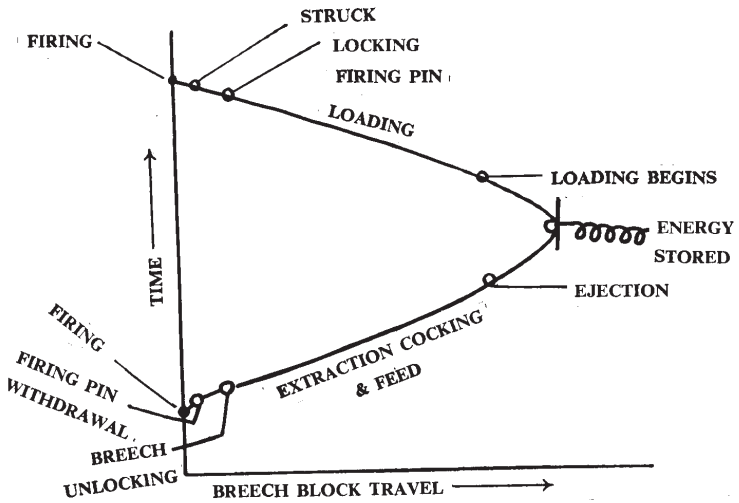


Fig. II-14

Automatic Action Cycle.

Graphic representation of one circle of the working of an automatic action.

The blow-back force cannot be utilised in ammunition using heavy loads or high velocity charges because in such cases, the breech end will open too soon unless the breech block is made very heavy. This difficulty is overcome by allowing the barrel, which is locked to the breechblock of the pistol, to slide backward along with the breechblock. The system is kept pressed in position by a spring. The sliding system, therefore, has to move backward against increasing resistance from this spring's pressure. The barrel and the breechblock disengage themselves after some time and breech block travel independently.

The breechblock performs all the functions mentioned in the blowback system. The two return to their original positions and get locked, ready for the next shot.

The safety devices are usually button or thumb pieces. Their manipulation can stop the operation of striker, hammer, sear or trigger, making the weapon safe. In some pistols the safety device is housed in the grip.

The usual parts, trigger, sear, the cocking and safety devices form part of the action of the pistol.

Fully automatic pistols are not very common. The difference between the semi-automatic (self-loader) and fully automatic pistol is small. In the former, the trigger must be released and pressed afresh for each shot, whereas in the latter, as long as the trigger is kept pressed, the firearm continues to fire till the magazine is exhausted. The rate of fire in an automatic is about five to thirty shots per second. The rapid rate of fire is inconvenient to the shooter. It is difficult to hold the pistol in position and aim it properly. Besides, at this rate the cartridges (about ten) in the magazine will finish too soon.

2. Barrel

The barrels of pistols are like the barrels of other rifled firearms. The length varies from about five to twenty centimetres. The number of grooves varies from four to eight. The direction of the grooves is often to the right but sometimes it is to the left, depending upon the manufacturer.

Pistols are available in many calibres, from about five to twelve millimetres. In some pistols, barrels form part of the sliding assembly. They are locked to the breechblock in the normal position and held together by spring action. They disengage after travelling rearward a short distance together.

3. Magazine

The magazine of a pistol is normally housed in its grip. It is taken out for reloading from the lower end of the grip. The capacity of the magazine varies from 6 to 20 rounds, usually.

Fig. II-15

10F.32 (7.65 mm) Pistol

9. MACHINE GUNS

9.1 Machine Guns

The machine gun is a fully automatic firearm designed to fire rifle ammunition. Because of the greater power of the cartridge, the blowback system of operation is not common in machine guns. Recoil and gas operations are common. The magazine may be the normal box type or ammunition may be fed from a belt.

There are proposals to introduce motorised cartridge feeling system to achieve very high rates of fire, for example, for in aircraft machine guns. Heavy and medium machine guns can only be fired when they are mounted on some kind of vehicle.

Machine guns have not been used much in crimes. However, their potential for mischief is so great that terrorist sees them with longing eyes.

They are of limited interest in forensic work.

In a machine gun, the rate of fire is very rapid – 300 to 1800 shots per minute, depending upon the feeding system. The excessive rate makes it imperative that the firearm is fired from a rest (bipod or tripod), placed on ground.

9.2 Light/Sub-machine Gun

A light machine gun, like a machine gun, is usually recoil operated. The sub-machine/light machine gun or machine pistols have the following characteristics:—

1. They fire pistol/rifle ammunition of the system.
2. They can act both as automatic or semi-automatic firearms.
3. They can be fired from the shoulder or from the hip.

Fig. II-16

Indian military's Machine Gun

10. MISCELLANEOUS FIREARMS

10.1 Air Rifle and Air Pistol

Air guns are useful for target practice and for killing small rodents. They are available mainly ln .177 and .22 calibre and have rifling in the barrel.

Air guns work on compressed air. When the trigger is pressed, compressed air is released into the barrelwith force (pressure). It pushes a specially made slug in front of it. The slug acquires a velocity of about 150 metres per second.

Ordinarily, no licence is required for an air gun in India. But if the projectile can penetrate 1.27 centimetres (= 0.5″) of deal (pine) wood at a range of 152.4 centimetres (60″), a licence is required for the gun. Air guns are ordinarily safe beyond a distance of 100 metres.

10.2 Cattle Gun

Cattle guns are specially made firearms to kill animals. A blank cartridge (9 mm or other calibre) is used in these firearms. The gases produced by the cartridge, on firing, bring into action a pointed bolt, about one centimetre in diameter and about five to ten centimetres in length. It flies forward and, through the muzzle, enters into the head of the animal against which the muzzle is kept pressed. The bolt retracts due to spring action after the forward force is spent. In some cattle guns, in place of the bolt, specially made slugs are used.

These guns are also known as humane guns. Butchers and farmers use them to kill animals in western countries. They have also figured there in crime now and then. In India, they are not common. The author has not come across this kind of gun even once in his service of 36 years.

10.3 Stud Guns

Stud guns are used to push projectiles (nails, studs) into wood, concrete, steel, etc., using specially made blank cartridges. They are far more powerful, therefore, they should not be used as normal weapons.

Stud guns are dangerous in spite of the provision of safety devices. They are capable of causing fatal injuries. They are not common in India.

10.4 Pest Guns

Pest handguns are usually of .22, .25, .32, .357, .44 calibre. They may have rifled or smooth bores. The projectile charge is, however, of pellets or 'dust'. They are used to kill pests like rats, snakes, etc. They are not common in India.

Table II-4

PEST AMMUNITION DATA

S. No.	*Cartridge*	*Make*	*No. of pellets (~)*	*Weight (g)*	*M Velocity (m/s)*
1.	.22	RWS	100	2	300
2.	.22	Winchester	170	3.5	320
3.	.38	Speer	140	6.6	–
4.	.44	Speer	190	8.9	–
5.	6 mm	Foichi	50	1	150
6.	9mm	Foichi	200	7.9	220
7.	9mm	RWS	185	3.5	160

[1]The criminals in India frequently use improvised firearms, presumably due to stringently licensing policy of the government.

The improvised firearms have many names. Country-made firearms is the commonest names. Standard ammunition is used in them. The calibre, shape and size of the firearm depend upon the availability of the ammunition, the barrel tube and the skill of the blacksmith. Even household plumbing pipes have been used for barrels in some cases, often with disastrous results. Ammunition is obtained either from licence-holder friends, refilled in discarded shells or purchased from unauthorised persons, who may have stolen the same.

There are large variations in the mechanism and the functioning of improvised firearms. The functioning of the firearms varies not only from the standard firearms (meant for the ammunition) but it also varies from one improvised firearm to another. In fact, no two improvised firearms, firing ammunition of the same make or even of the same batch will give similar ballistics. Consequently the range, the wounding power and the reliability vary so much that no generalisations involving them can be safely made.

The variations in the firearms are mainly due to:—

1. The barrels of the firearms differ in length.
2. The bore diameters or calibres of the barrels differ. They may be larger or smaller for the ammunition fired through them.
3. The internal surface of the bore may be too rough to give consistent results.
4. The firing mechanism may be defective.
5. The breech may not close properly.
6. The chamber may be tight or loose.

Most of the improvised firearms are very dangerous. The barrel may get hinged off at the time of fire, it may burst or there may be excessive recoil.

The following points about improvised firearm ballistics may be noted:—

1. The firearms become increasingly dangerous with each subsequent shot due to poor artisanship. Certain characteristics also change.
2. They are effective at short ranges only as the combustion of propellants is often incomplete and the extent of combustion varies from shot to shot. The wounding effect is, therefore, unpredictable.
3. The generalisations made for the ammunition by the manufacturer, for standard firearms, do not hold good. Even results of experiments with the same firearm are only rough approximations.
4. They do not permit accurate or even approximate estimates of range from the spread of pellets or direction of wound. The direction may have suffered change due to some abnormality in the internal surface of the bore near the muzzle end. Such abnormalities give variations in different shots with the same firearm.
5. The data collected for one firearm cannot be used for a second improvised firearm, even if the ammunition of the same make and batch is used.

1. *See* chapter on Improvised Firearms.

6. The projectile charge including wads may get deformed.
7. The marks imprinted on the projectiles or shells fired from improvised firearm are numerous and characteristic, which facilitate the identification of the fired ammunition.
8. The irregularities in the ballistics in some firearms make it extremely difficult to reconstruct the occurrence or sequence of events correctly.
9. Some improvised firearms may have some standard components. The components would behave normally unless improvised parts affect their functioning.

Fig. II-17

Pellets spread from an improvised firearm. Range 3 metres, barrel length 15 cm. With standard gun, a single rat hole is formed at this range.

The quality of improvised firearms varies tremendously. Some of these firearms can be easily mistaken for standard factory-made firearms if a detailed examination is not made. Others are too crude to be used for firing. No test firing should be carried out with some of these firearms in the usual way. If the same has to be done, it must be ensured that no accident takes place.

The improvised firearms (over a thousand) seen and examined by the author used standard ammunition or refilled standard cartridges. Most of them used 12 bore shotgun ammunition. Others used .303 ammunition. Only a few were chambered for other calibre ammunition.

APPENDIX

INDIAN ORDNANCE FACTORY FIREARMS[1]

A few decades ago, almost all the firearms, especially the rifled firearms, used in India, were imported. Indian Ordnance Factories are now manufacturing most of the small arms needed in the country. Criminals are acquiring them by legal or illegal means and using them to commit crimes. The law enforcement agencies and others concerned with the criminal justice system (the lawyer an the judge) need to know about them and their characteristics. The following pages in the appendix describes most of the salient feature and data about them. It is hoped the information proves useful to all the concerned persons, especially to the lawyer and the judge in addition to the investigator.

1. 0.22″ Revolver

1.1 Technical Data

- Calibre 0.22″
- Weight 380 gms
- Barrel length 66 mm
- Capacity 8 rounds
- Ammunition 0.22″ x 24.8 mm
- Grip Wooden
- Overall size Length 187 mm
  Width 116 mm
- Range 20 Metres
- Action Single and Double both
- Pin Firing Floating

2. Revolver .32 (7.65 mm x 23)

2.1 Role

Light weight, easy to handle weapon, suitable for personal safety.

2.2 Functioning

.32 (7.65 mm) Revolver is capable of firing 6 rounds, loaded in revolving chambers. Misfiring of a round does not affect next firing.

2.3 Safety

Positive location of main spring eliminates malfunctioning and additional safety feature provided to prevent accidental firing.

2.4 General Characteristics of Revolver .32 (7.65 mm)

a. Simple in design and sturdy in construction.
b. Positive location of main spring eliminates malfunctioning.

1. Source: Internet

c. During non-functioning of weapon, springs are not under fatigue.
d. Misfiring of a round does not effect next firing.
e. Accuracy aimed at high standards.
f. High grade of alloy steel with heat treatment achieve durability.
g. Interchangeability of parts ensured.
h. Provided with additional feature of safety to prevent accidents.

2.5 Technical Data

• Nomenclature	Revolver 32 (7.65 mm)	
• Calibre	7.65 mm	
• Weight (Without Ammunition)	0.7 kg	
• Length of Revolver	177.8mm	
• Barrel	76.2 mm	
• Rifling	Six Grooves R.H. 1 Turn/381 mm	
• Sights	Foresight	Blade
	Backsight	'U'
• Feed	Revolving Chamber, 6 Rounds	

3. Pistol 0.32″

3.1 Technical Data

• Calibre	0.32″
• Magazine	Box type capacity: 8 cartridges
• Barrel length	3.44″ approx.
• Chamber	Suitable for 0.32″ ACP Rimmed Cartridges
• Weight of Pistol	0.68 kg. (with empty magazine)
• Sight	Fixed
• Safety	On left side of receiver
• Trigger pull	5 to 7 Ibs.
• Rifling	6 grooves spiral 1 in 16 inch, RH
• Action	Semi-Automatic, simple Blow Back
• Dimensions	Length - 158 mm, Height - 105 mm, Width - 25 mm
• Range	27.5m

4. Pistol Auto 9 mm 1A

4.1 General

A personal and special service weapon capable of semi-automatic fire. It is a recoil operated, magazine fed, self-loading pistol in which the breech is positively locked at the moment of firing. It is not fully automatic. The trigger has to be pressed and released for each shot. When all the cartridges have been fired and the magazine is empty, the mechanism is held in the open position by the action of the slide.

4.2 Specification

- Calibre 9mm
- Weight with magazine empty 0.935 kg
- Weight with magazine loaded 1.075 kg
- Length Over all 205 mm
- Barrel length 120 mm
- Magazine Capacity 13 rounds
- Ammunition used Cartridge SA Ball 9 mm MK.2z(Parabellum)
- Rifling 6 grooves, 1 turn in 254 mm, R.H.
- Muzzle Velocity 396.23 m/sec.
- Number of components 54
- Range 50 mts

5. .22″ Sporting Rifle

5.1 Specification

- Calibre .22 inch L.R
- Barrel Length 632 mm
- Chamber International standard L.R (5.70 mm x 16.50 mm)
- Groove 6 Nos. R.H. 1 Turn in 200 mm
- Range 200 m Max.
- Safety On rear end top of the body by turning lever safety
- Trigger pull Adjustable (Minimum 1 kg)
- Weight of the Rifle 3 kg. Approx
- Overall length 1092 mm
- Furniture Wooden
- Magazine capacity 10 rounds

5.2 Special Features

a. Cold swaged, Six grooved, Chrome-flashed barrel with International standard L.R. Chamber
b. Double action extraction mechanism provided for smooth extraction.
c. Adjustable Rear Sight with "Left-Right" adjustment.
d. Adjustable Fore-sight with "Hi-Lo" adjustment

e. Adjustment trigger pull.
f. Front sling loop position adjustable.
g. Comfortable, smart looking, one piece Stock Butt satisfying U.I.T. specification.
h. Safety catch positioned comfortably.
i. Over body dovetail provided for Standard Peep Sight.

6. .315" Sporting Rifle

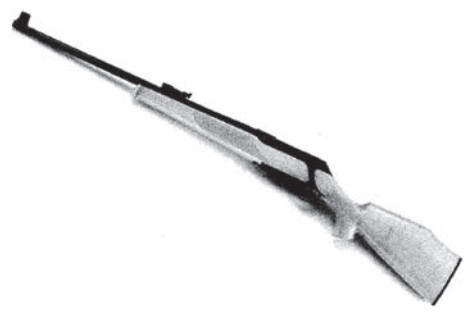
6.1 Performance

With Standard Ammunition, the dispersion area will be 101.6 mm x 101.6 mm at 91.34 meters (100 Yds) and 304.8 mm x 304.8 mm at 274.32 meters (300 Yds) with a series of 6 shots with one elimination in both the cases.

6.2 Specifications

- Calibre — 8 mm (.315")
- Overall length — 44"/1117mm(approx)
- Length of Barrel — 640 mm
- Rear Sight — Open sight with two leaves Graduated to 91.44 Meters (100 Yds) and 274.32 Meters (300 Yds)
- Range — 275 Meters
- Trigger Pull — 2.27 to 2.72 Kgs
- Weight of Rifle — 3.34 Kgs (approx) (without magazine)
- Magazine — Box type, Capacity-5 cartridges.

7. 30-06 Sporting Rifle



7.1 Technical Features

- Calibre: — 0.30"
- Range: — 400 m
- Weight: — 3.0 Kg
- Magazine Capacity: — 03 Rounds.
- Foresight: — Adjustable type
- Rear-sight: — Adjustable ramp type

[From 100 to 400 m, graduation in steps of 100 m.]

7.2 Other Features

a. Direct Lug Locking with the Barrel.
b. Barrel: Chrome Flash with 4 Grooves.
c. Trigger Pull: 1.5 Kg. (Max).

Note: As per decision of Ministry of Home Affairs, Government of India, the sale of 30-06 Sporting Rifle (NPB) will be restricted to only those persons/shooters who hold a specific licence for 30-06 Sporting Rifle for sports and not for hunting purpose.

8. 12 Bore PUMP Action Gun

8.1 General

The 12 Bore Pump Action Gun has been specially developed for use as a security weapon. It is a single barrel breach loading weapon superior to 12 Bore DBBL. It is provided with a tubular magazine, which holds 4 nos. of 12 Bore Cartridges and is placed parallel to and below the barrel. Extraction, loading and cocking of the cartridges take place in a single 'pump action' by operating handle, sliding along the magazine. Due to rapid reloading by pump action and spread of shots, it is an ideal weapon for counter ambush tactics.

8.2 Specifications

- Weapon — Single Barrel Breach Loading
- Calibre — 12 Bore (18.578 mm to 18.628 mm)
- Chamber — 70 mm (2-3/4″)
- Length of Barrel — I. Civilian use - 510 mm (20″) NPB
  II. Military/Police - 478 mm (18″) PB
- Ammunition — 12 Bore 2.5″ OR 12 Bore 2.75″
- Magazine Capacity — 4 Rounds
- Weight — 3.05 kgs.

8.3 Applications

a. Banks security
b. Anti insurgent applications
c. Industrial security
d. Personal security
e. Sporting Arm
f. Anti Riot role by use of Rubber Ball non-lethal ammunition

9. 5.56 mm Assault Rifle (Fixed Butt)

9.1 General

a. Outcome of the untiring effort of a dedicated group of design engineers, this light weight Assault rifle is intended for use by Infantry operating without continuous logistic support and in adverse conditions as in jungles, mountains and difficult terrain.
b. This gas operated special elite weapon has a unique feature in respect of its mode of firing and safety.
c. The Rifle can fire in single shot, three round burst and also automatic mode. A simple action of lever change situated conveniently provides applied safety.
d. Additional mechanical safety is provided by means of Safety sear and built-in 'delay' in breech mechanism.
e. This is versatile and compact weapon. Exceptional ease of assembly and dismantling, chrome plated barrel and chrome plated pin firing give the weapon

distinct advantages over similar weapons available world over. It is robust and can withstand rough handling.

f. It has unparalleled accuracy and its chamber is compatible with NATO ammunition SS 109 and M 193.

g. It is fitted with simple mount for sighting aids such as Passive Night Sight/ Daylight Telescope.

h. Furniture items are made of impact resistant Plastics and vapocured in leaf brown/black colour. Its attractive looks inspire confidence.

i. Magazines are made of transparent plastic (UV stabilised pre-coloured poly carbonate Resin) with 20 Rds. capacity.

j. This Rifle is supplied with a multi-purpose Bayonet and its Flash Eliminator is designed to adopt Blank Firing and Grenade Launching attachment.

9.2 Technical Data

- Calibre 5.56 mm
- Length of weapon 960 mm
- Weight of weapon
- Without magazine 4.15 kg
- With full magazine 4.5 kg.
- Recoil Energy 4.45 Joules
- Barrel Chrome plated
- PNS/Day light Telescope Provided
- Range 400 m
- Mode of Firing Single shot, three round burst and automatic – Gas operated.

10. 5.56 mm INSAS Rifle (Foldable Butt)

10.1 General

a. It resembles 5.56 mm Assault Rifle Fixed Butt in all other features except that the Fixed Butt is replaced with a foldable type of Butt to shorten the overall length and it does not include automatic mode of firing.

b. It is most suitable for combat from ICV and in Para troopers role.

10.2 Technical Data

- Calibre 5.56 mm
- Length in folded condition 750 mm
- Weight of weapon
- Without magazine 4.25 kg
- With full magazine 4.6 kg
- Recoil Energy 4.43 Joules
- Barrel Chrome plated
- PNS/Daylight Telescope Provided
- Range 400 m
- Mode of Firing Single shot, three round burst. Gas operated.

11. Rifle 5.56 mm INSAS (Fixed Butt)

11.1 General

a. Accurate lightweight rifle, compact and handy, suitable for terrestrial and maritime assignments.
b. Gas-operated rifle can fire in single shot and three round burst (TRB) for conservation of ammunition. A simple action of lever change allows selection of single shot, TRB and safe position.
c. Additional mechanical safety is provided by means of safety sear and built-in delay in breech mechanism.
d. Easy to assemble and dismantle, chrome-plated barrel and chrome-plated pin firing ensures maintenance free long life.
e. Compatible with NATO standard ammunition 5.56 x 45 mm SS 109, M 193.
f. Quick mounting of Passive Night Sight/Daylight Telescope.
g. Stock, Pistol Grip and Hand Guard made of impact resistant plastic in leaf brown colour.
h. Magazines are made of transparent UV stabilised polycarbonate Resin.
i. Multipurpose bayonet functions as Saw, Wire cutter, Bottle opener, Knife, Screw driver, Hammer and Dagger.
j. Flash Eliminator is designed to adopt Blank firing attachment.
k. Block gas and grenade sight provided for firing multimode grenade and M-36 grenade.

11.2 Specifications

• Calibre (mm)	5.56	
• Muzzle Velocity (m/s)	900	
• Length of Rifle (mm)	Without Bayonet	960
	With Bayonet	1110
• Weight of Rifle (Kg) Without Magazine & Bayonet	4.15	
• Effective Range (m)	400	
• Range for Grenade (m)	200	
• Multi Mode	150	
• M 36		
• Magazine Capacity (Rounds)	20	
• Cyclic Rate (Rounds/min)	600 to 650	
• Trigger Pull (Kg)	2.10 to 4.00	
• Recoil Energy (Joules)	4.43	
• Barrel Groove	6 grooves R.H 1 in 200 mm.	
• Sight	Foresight: Post Type Rearsight: Aperture type	
• Type of fire	Single, 3 Round Burst	

12. Rifle Excalibur 5.56 mm

12.1 General

Derived from the famous INSAS weapon systems of India which have been tested in large scale infantry combat, anti-terrorist and mob control situations, this weapon is called the INSAS EXCALIBUR MARK-I incorporates, in addition to the features of earlier INSAS Weapons, certain characteristics which makes it truly the ultimate sword- "THE EXCALIBUR". The reasons for calling it Excalibur are that it incorporates the features of a weapon which is rugged for battlefield engagements and at the same time capable of being light and easy to handle during low intensity conflict and CQB situations. It has ergonomically designed with folding butt and can hold both 20-30 rounds magazines. It is also fitted with picaatinny rails for mounting of opto electronic devices.

12.2 Specifications

• Calibre	5.56mm
• Length-Butt Folded/Butt Extended	665mm/895mm
• Weight without Magazine	3.81 kg.
• Weight with Full Magazine	4.03 kg
• Weight of Empty Magazine	0.09 kg.
• Magazine Capacity	20/30 rounds
• Length of Barrel	400 mm
• Barrel Chamber and Bore	Chrome Plated
• Rifling (No. of Grooves/Twist/Direction)	6/1 turn in 200/RH
• Sight (Front/Rear/Range Graduation/ Radius)	Post type/aperture/200 mm and 400mm/475mm
• System of Operation	Gas operated
• Mode of Fire	(i) Single Shot (ii) Automatic
• Rate of Fire (rounds/min)	650 to 700
• Effective range	400 m

13. MINSAS 5.56 mm Personal Carbine

13.1 General

a. MINSAS Carbine 5.56 mm is specially designed and developed for close quarter battle (CQB) role
b. It fires specially developed 5.56 x 30 mm ammunition.
c. The weapon is ergonomically designed, light in weight, easy to carry, handle, operate and maintain.
d. Barrel of the weapon is chromium plated for longer life.
e. It has ambidextrous lever change operation.
f. It is provided with Reflex sight and Bayonet as accessories.

13.2 Technical characteristics

- Calibre 5.56 mm (5.56 x 30 mm Ammunition)
- Sight Radius 420 mm
- Length of Weapon - (a) Butt Folded 565 mm
- Length of Weapon - (a) Butt Extended 775 mm
- Weight - Weapon (without Magazine) 2.8 kg
- Weight - Magazine (empty) 240 gm
- Weight - Cartridge 8.0 gm
- Effective Range 200 m
- Operation Gas operated, Rotary bolt
- Mode of Fire Single & Auto
- Magazine 30 Rounds. Box type Magazine
- Rate of Fire 700 rpm
- Muzzle velocity 650 m/sec

13.3 Barrel

- Length of Barrel 330 mm (Chromium plated)
- Bore Diameter H - 5.612 mm L- 5.577 mm
- Number of Rifling Grooves 6
- Twist of Rifling Grooves Right Hand
- Lead of Rifling Grooves 1 turn in 200 mm

14. LMG 5.56 mm INSAS (Fixed Butt)

14.1 Role

The weapon is used for providing covering fire during assault by infantry.

14.2 Functioning

LMG 5.56 mm is a gas operated weapon with rotating bolt locking system which can fire in S.S./Auto system.

14.3 LMG: Technical Data

Nomenclature	Unit	LMG 5.56 mm INSAS (Fixed Butt)
Calibre	mm	5.56
Wt. w/o Magazine	kg	6.23
Wt. w/loaded Magazine	kg	6.73
Length Overall	mm	1050
Barrel length	mm	535
Sight Radius	mm	475
Magazine Capacity	Rounds	30
Fire selection	Rounds	SS/Auto
Rate of fire (cyclic)	Rpm	650
Effective range	M	700
Muzzle velocity	M/s	925
Muzzle energy	J	1780
Recoil energy	J	2.75

14.4 Safety

The system is provided with mechanical and applied safety.

General Characteristics of LMG 5.56 mm INSAS

i. Light weight weapon
ii. Commonality of parts amongst the LMG and Rifle, 5.56 mm INSAS.
iii. Weapon is very compact, easy to handle, operate and simple to maintain.
iv. Weapon robust enough to withstand rough usage.
v. Furniture made of Plastic materials
vi. Foldable Butt version available to suit paratroopers also
vii. Barrel Bore Chrome plated for high Barrel life and ease of maintenance
viii. Provided with mount for PNS and Telescope, with day light telescope and passive night sight
ix. Provision for mounting on tripod, armed vehicles for Anti-Air Craft role and Monopod (for fixed line firing)

15. LMG 5.56 mm INSAS (Foldable Butt)

15.1 Role

The weapon is used for providing covering fire during assault by infantry. It resembles LMG 5.56 INSAS fixed butt in all features except that it has a foldable butt as well as a shorter barrel to reduce the overall length so that it can be suitable for combat from ICV and can be used by paratroopers.

15.2 Functioning

LMG 5.56 mm is a gas operated weapon with rotating bolt locking system which can fire in S.S./Auto system.

15.3 Safety

The system is provided with mechanical and applied safety.

15.4 LMG: Technical Data

• Nomenclature	Unit	LMG 5.56 mm INSAS (Foldable Butt)
• Calibre	mm	5.56
• Wt. w/o Magazine	kg	5.87
• Wt. w/loaded Magazine	kg	6.37
• Length Overall	mm	1025
• Barrel length	mm	500
• Sight Radius	mm	475
• Magazine Capacity	Rounds	30
• Fire selection	Rounds	SS/Auto
• Rate of fire (cyclic)	Rpm	650
• Effective range	M	600
• Muzzle velocity	M/s	915
• Muzzle energy	J	1740
• Recoil energy	J	2.85

15.5. General Characteristics of LMG. 5.56 mm INSAS

i. Light weight weapon
ii. Commonality of parts amongst the LMG and Rifle 5.56 mm INSAS
iii. Weapon is very compact, easy to handle, operate and simple to maintain.
iv. Weapon robust enough to withstand rough usage.
v. Furniture made of Plastic materials.
vi. Foldable Butt version available to suit paratroopers also.
vii. Barrel Bore Chrome-plated for high barrel life and ease of maintenance.
viii. Provided with mount for PN_s and Telescope, with daylight telescope and passive night sight.
ix. Provision for mounting on tripod, armed vehicles for Anti-Air Craft role and Monopod (for fixed line firing).

16. Zittara Multi-purpose Carbine

16.1 General

a. Weapon capable of being used in an assault rifle role with capability to fire 5.56 X 45 mm rounds with an accuracy up to 300 m
b. Weapon capable of being used in a carbine role with capability to fire 5.56 X 30 mm and 9 x 19 mm rounds with accuracy up to 200 m
c. Bull pup configuration making the weapon only 59 cm long and 3 Kg in weight
d. Integrated aiming system - Reflex sight + integral laser pointer
e. Day and night continuous fighting capability - No zeroing needed.
f. Ideal for Close Quarter Battle (CQB) with all calibers owing to all the above features
g. Advanced ergonomic design
h. Compact rifle with long barrel - High accuracy
i. Rear center of gravity - Comfort in shooting and holding - Improved hit probability.
j. Appropriate for right or left-hand shooter
k. Interchangeability of barrel and magazine for both calibers
l. Advanced sighting system attached directly to barrel.
m. Adjustment of optical system for continuous day and night fighting.

16.2 Characteristics

	5.56 x 45 mm INSAS and NATO	5.56 x 30 mm	9 x 19 mm
• Weight (Weapon only)	3 kg	3 kg	3 kg
• Method of operation	Closed Bolt Position	Closed Bolt Position	Blow Back
• Total Length	59 cm	59 cm	59 cm
• Barrel length	33 cm	33 cm	33 cm
• Muzzle Velocity	890 m/sec	650 m/sec	410 m/sec
• Rate of Fire	750 - 950 rounds/min	900 rounds/min	650 rounds/min
• Magazine	30 rds	30 rounds	30 rounds

17. Rifle 7.62 mm 1A1

17.1 General

This is a self-loading gas operated and air-cooled rifle. A gas cylinder and an adjustable gas regulator are fitted on the top of the barrel. The amount of gas acting on the piston is controlled by the gas regulator to ensure smooth functioning of the Rifle. A flash eliminator is fitted on the muzzle end on which a bayonet can be fitted. A projector grenade can also be fitted for grenade firing.

17.2 Specification

• Length of Rifle with normal butt	44.85 in/1139.19 mm
• Length of Barrel	21 in/533.4 mm
• Bore dia	L 0.297 in/7.5436 mm H 0.299 in/7.5946 mm
• Number of Grooves	6
• Twist	R.H.
• Pitch of Rifling	1 turn in 12 inch/304.8 mm
• Weight of rifle with full magazine Sling and bayonet	12 Ibs 2 oz/5.50 kg.
• Weight of rifle with empty Magazine	10 lbs 4 oz/4.649 kg.
• Weight of rifle without magazine	9 lbs 11 oz/4.396 kg
• Fore sight	Adjustable Pole type
• Back sight	Aperture Graduated 200-600 yds./182.88 -548.64 M
• Maximum effective range	600 yds/548.64 M
• System of operation	Gas
• Type of Magazine	Box
• Weight of full Magazine	1 Ib 9 oz/0.708 kg.
• Weight of empty magazine	9 oz/0.255 kg.
• Magazine capacity	20 rounds
• Rate of fire	60 rounds per minute
• Capability of being fitted with Projector grenade	Can be fitted
• Type of Bayonet	Bayonet, 2 A, having 10" long blade/ 254 mm
• Muzzle velocity	822. 93 M/s ± 9.14M/S
• Sight radius	21.77 - 552.95 mm
• Trigger Pull	6 to 9 Ibs/2.72 to 4.08 kg.
• Ammunition	Cartg. SA ball 7.62 mm NATO.

18. Assault Rifle 7.62 mm [Fixed & Foldable Butt]

18.1 Role

The weapon is ideal for counter insurgency using 7.62 X 39 mm ammunition. It is robust enough to withstand rough usage. Barrel of the weapon is Chromium plated for longer life. The

rifle is also provided with a Hold open device for cooling and inspection of chamber & Lock retainer which makes opening and closing of cover easy.

18.2 Functioning

Assault Rifle 7.62 mm is a gas operated weapon with rotating bolt locking system which can fire in single shot/auto mode.

18.3 Technical Characteristics

• Calibre	7.62 mm		
Length	Fixed Butt	900 mm	
	Foldable Butt	Butt Extended	890 mm
		Butt Folded	660 mm (Bottom Folding)
	Barrel	414 mm	
• Weight (without magazine and Sling assembly)	Fixed Butt	3.08 Kg	
	Foldable Butt	3.27 Kg	
• No. of Riffling Grooves	4		
• Operating	Gas, Selective Fire (Auto)		
• Locking	Rotary Bolt		
• Feed	30 Rounds. Box Magazine		
• Sight	Fore-Pillar, Rear-'U' Notch, Graduated, Ramp type 100-800		
• Effective Range	400 M		
• Sight Radius	376 mm		
• Rate of Fire (cyclic)	600 Rds/Min		
• Muzzle Velocity	670 M/S		
• Muzzle Energy	1750 J		

18.4 Safety

The system is provided with mechanical and applied safety.

18.5 Salient Features

a. Fires 7.62 x 39 mm ammunition
b. An ideal weapon for counter insurgency
c. Compact design, easy to carry, handle, operate and maintain
d. Robust enough to withstand rough usage
e. Chromium plated barrel for longer life of weapon
f. Hold open device for cooling and inspection of chamber
g. Available in fixed butt and bottom folding butt versions

19. Gun Machine 7.62 mm (MAG) 5A (Co-axial) & MO-32 (Air)

19.1 Specifications

• Calibre	7.62 mm
• Weight	
• Gun	11 Kg
• Barrel Assy	2.6 Kg
• Length	1048 mm
• Barrel Assy	680 mm
• Rifling	

- No. of Grooves 4
- Pitch of Rifling 1 Turn in 305 mm
- Twist of Rifling Right Hand
- System of Operation Gas Operated
- Rate of Fire 750 ± 50 RPM
- Feeding Belt Fed Model 5A (Co-axial) Available With Left Hand Feed Model Mo-32 (Air Version) Available With Both Right Hand Feed and Left Hand Feed.
- Belt Type Disintegrating Links
- Belt Weight (235 Rounds) 6.8 Kg

Note.—Model 5A (Coaxial Version) is fitted with Trigger. Model MO-32 (Air Version) is not fitted with Trigger and is Remote Fired by Solenoid.

20. Gun Machine 7.62 mm (MAG) 6A

20.1 General

The weapon is designed for use with MBT mounted co-axially in the Turret. In case of emergency Gun Machine (MAG) 7.62 mm 6A can be dismounted from the turret of the tank and can be used as ground role MMG.

This is gas operated, air-cooled, belt fed machine gun firing bursts only. In the ground role, the 6A gun is fired from mounting tripod 7.62 mm MG L4A1. The gun is fired from an open breech thus preventing any cook-off after prolonged use. The weapon is provided with a gun barrel an a spare barrel which can quickly and easily be changed to avoid over heating which causes cook off and reduction in barrel life. The gun is provided with a light barrel, the bore and chamber of which is chromium plated. The feed is from left to right with belts of disintegrating links which are ejected to the right. Empty cartridge cases are ejected downwards.

20.2 Specification

- Calibre 7.62 mm
- Gun Weight 11 kg.
- Barrel Assy 3.15 kg.
- Gun Length 1048 mm
- Barrel Assy 680 mm
- Rifling
  - No. of Grooves 4
  - Pitch of Rifling 1 Turn in 305 mm
  - Twist of Rifling Right Hand
- Sight
  - Rear Aperture
  - Fore Blade
  - Marking 200 to 1800 M
- System of Operation Gas Operated

- Rate of Fire
  Cyclic — Adjustable 600 to 1000 RPM
  Operational — 200 RPM
- Feeding — Belt Fed (Left Hand)
- Belt Type — Disintegrating Links
- Belt Weight (235 Rounds) — 6.8 Kg

21. Gun Machine 7.62 mm '1B'

21.1 General

A light machine gun capable of delivering a high volume of fire and engaging moving ground targets. It is air-cooled gas operated and magazine fed for fully automatic or semi automatic fire. It can be fired from a bipod/tripod. The gun is supplied with two barrels, which may be quickly changed in the event of over heating. The barrels are fitted with flash eliminator and gas regulator.

21.2 Specification

- Calibre — 7.62 mm
- Length of Weapon — 1130.30 mm
- Weight of Weapon with Loaded Magazine — 10.35 Kg
- Weight of weapon with Empty magazine — 9.64 Kgs
- Type of Magazine — Box
- Magazine Capacity — 30 Rounds
- Weight of Empty Magazine — 0.40 Kgs
- Weight of Loaded Magazine — 1.11 Kgs
- Type of Sight used with Range Setting:
- Fore Sight — Adjustable Blade Type
- Back Sight — Adjustable Aperture Slide and Leaf Type
- Range Setting — 182.8 meters to 1828.8 meters
- Effective Range — 457.2 meters
- Maximum Range — 1828.8 meters
- System of Operation — Gas Operated, Positive Locking
- Ammunition — Cartridge SA 7.62 mm Ball 'A'
- Cycle Rate of Firing Per Minute — 500 Rounds
- Rate of Firing Single Per Minute — 60 Rounds
- Total Number of Components — 143
- Total Number of assembly/ Sub assembly — 23

21.3 Barrel

- Length of the Barrel — 538.48 mm
- Bore Diameter — H 7.595 mm/L 7.544mm
- Number of Rifling Grooves — 6

- Twist of Rifling Grooves — Right Hand
- Lead of Rifling Grooves — 304.8 mm

21.4 Performance

With standard 7.62 mm ball NATO ammunition the dispersion area will be 38.1 mm x 38.1 mm at 22.86 meters and 152.4 mm x 152.4 mm at 91.44 meters with a series of 5 shots with one elimination each in both the cases.

22. Gun Machine 7.62 mm (MAG) 2A1

22.1 General

The weapon is designed to serve the role of a medium machine gun and is fired from a tripod mounting. It is fully automatic, air cooled, belt fed, gas operated weapon capable of a sustained high rate of fire in bursts. The gun fires from open breech thus preventing any explosion of a cartridge (cook off) after prolonged firing. The gun is provided with a heavy/light barrel, the bore and chamber of which are chromium plated. The weapon is supplied with a gun barrel and a spare barrel which can be quickly and easily changed to avoid over heating which causes cook off and reduction in barrel life. The gun is fed from left to right with belts of disintegrating link which are ejected to the right. Empty cartridge cases are ejected downwards.

22.2 Specification

- Calibre — 7.62 mm
- Weight of Gun — 11 Kgs
- Overall length — 1048 mm
- Rate of Fire — Adjustable 600 to 1000 rounds/Minute
- Max Range — 1800 M
- Belt — Disintegrated link
- Total No of Components — 219
- Sight Rear Aperture Graduated — Steps of 100 M
- Folder Down — 200 to 800 M
- Extender — 800 to 1800 M
- Barrel:
  - (i) Length of Barrel — 545 mm
  - (ii) Bore Diameter — H 7.655/L7.61mm
  - (iii) Number of Grooves — 4
  - (iv) Pitch of Rifling — 1 Turn in 305 mm
  - (v) Twist of Rifling — Right Hand

22.3 Ammunition

7.62 mm NATO Ball Ammunition

23. Sub Machine Gun Carbine 9 mm 2A1 (Silent Version)

23.1 General

Sub-Machine Gun 9 mm, Carbine 2A1 is a special purpose weapon for use in clandestine roles. It is fitted with a silencer unit at the front of the barrel which is easily replaceable. It is operated by spent case projection or blow back action, The sound of explosion is effectively reduced by expansion of gases through the drilled holes of the barrel and is controlled through the silencer unit. When fired, it produces only the mechanical sound of moving parts. It is a light-weight easy to handle weapon, capable of automatic firing.

23.2 Specification

• Calibre	9 mm
• Length with Butt	902 mm
• Length with Folded Butt	698 mm
• Length of Barrel	198.12
• Bore Dia High -	8.89 mm
Bore Dia Low-	8.814 mm
• Nos. of Grooves	6
• Twist	Right Hand
• Pitch of Rifling	1 turn in 250 mm
• Weight of Weapon with loaded Magazine and Sling	4.76 Kg
• Weight of Weapon with Empty Magazine	4.00 Kg
• Type of sight used with Range Setting	
• Fore Sight	Adjustable Fore Sight
• Back Sight	Aperture Peep Type
• Range Setting	91.44 M to 182.88 M
• Effective Range	27.34 M (30 Yds)
• Maximum Range	91.44 M (100 Yds)
• System of Operation	Blow back self loading type
• Type of Magazine	BOX
• Magazine capacity	34 Rounds
• Weight of Empty Magazine	0.280 Kg
• Weight of Full Magazine	0.688 Kg
• Cyclic Rate of fire per minute	150 rounds
• Rate of Fire single per minute	68 rounds
• Type of Bayonet used	nil

24. Sub Machine Gun Carbine 9 mm 1A1

24.1 General

A short range personal weapon capable of being used upto 183 m. It is operated by spent case projection or blow back action and is capable of firing in fully automatic or single shot modes. It is fitted with a hinged collapsible butt and may be fired with the butt in the extended or folded position. The casing is in one piece and carries a bayonet boss at the forward end for fitting of bayonet.

24.2 Specification

• Calibre	9 mm
• Length of the Weapon with Butt Extended	685.8 mm
• Length of the Weapon with Butt Folded	482.6 mm
• Weight of the Weapon with Loaded Magazine & Sling	3.82 Kg
• Weight of the Weapon with Empty Magazine	3.06 Kg
• Type of the Magazine	Box
• Magazine Capacity	34 Rounds
• Weight of the Empty Magazine	0.226 Kgs
• Weight of Magazine (Loaded)	0.680 Kgs
• Type of Sight used with Range Setting:	
• Fore Sight	Adjustable Blade Type
• Back Sight	Aperture Peep Type
• Range Setting	91.44 meters to 182.88 meters
• Effective Range	27.43 meters
• Maximum Range	182.88 meters
• System of Operation	Blow Back Self Loading Type
• Ammunition	Cartridge SA 9 mm Ball Mk.2Z
• Cyclic Rate of Firing per minute	550 Rounds
• Rate of Firing Single per minute	68 Rounds
• Type of Bayonet used	Blade Type
• Total number of Components	109
• Total number of assembly/Sub assembly	19

24.3 Barrel

Length of Barrel	199.34 mm
Bore Diameter	H 8.890 mm, L 8.814 mm
Number of Rifling Grooves	6
Twist of Rifling Grooves	Right Hand
Lead of Rifling Grooves	1 turn in 250 mm

24.4 Performance

When fired with standard ammunition the dispersion will be 101.6 mm diameter with a series of 5 shots with no elimination.

AMMUNITION

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9. POLICE AMMUNITION

9.1 Pellet Pouch Projectiles

9.2 Fragile Bullets

APPENDIX

3

AMMUNITION

Ancient Greek lead sling bullets, ca. 100 g. 4th century BC. (From Greece)

1. GENERAL

Ammunition[1] in law includes a host of items. For the purposes of forensic ballistics, and in common language, however, ammunition means cartridges, propellants, primers and projectiles commonly used in small firearms. In crimes, usually small arms are involved though terrorist have changed the scenario somewhat. They are also using light machine and machine guns in their activities. The discussion here, therefore, is limited mainly to the ammunition of small arms only.

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1. According to the Arms Act, 1959, Ammunition means: "Ammunition for any firearm" and includes:—
   (1) Rockets, bombs, grenades, shells and other like missiles.
   (2) Articles designed for torpedo service and sub-marine mining.
   (3) Other articles containing or designed or adapted to contain explosive, fulminating or fissionable material or noxious liquid, gas or other such thing whether capable of use with firearms or not
   (4) Charges for firearms and accessories for such charges.
   (5) Fuses and friction tubes.
   (6) Parts of and machinery for manufacturing ammunition.
   (7) Such ingredients of ammunition as the Central Government may by notification in the official gazette specify in this behalf.

A firearm cartridge has the following components:—

1. Cartridge case or shell;
2. Primer;
3. Powder;
4. Wads;
5. Projectile(s); and
6. Lubricants

2. PROPELLANTS

Propellants are the materials, which propel the projectiles used in small arms. They are usually chemical or mixtures of chemicals, which on initiation burn rapidly and produce large amount of gases. As the gases are produces in a confined space on rapid burning, they develop high pressure that imparts high velocity to the projectiles place in front of the powder.

There is a variety of propellants including the following:

2.1 Black Powder

Prior to 1842, the only propellant known and being used in firearms was black powder. It was also known as gunpowder. Its composition varied in the early stages but over the centuries, it has come to be:—

Table III-1

Potassium nitrate (KNO_3)	= 75%
Sulphur (S)	= 10%
Charcoal (C)	= 15%

Sodium nitrate in place of potassium nitrate has also been used.

The intimate mixture of the three ingredients is prepared carefully. The process is hazardous. The final product is obtained in various grain sizes. The size controls, to some extent, the rate of burning. 'F' and 'g' letters designate various grades. Additional Fs indicate the fineness of the grain.

Table III-2

Designation	*Mesh Limits*
Grade I	6-10
Fg	10-14
FFg	14-24
FFFg	24-46
FFFFg	46-60

The black powder is glazed and polished to increase its storing (keeping) qualities. The shining surface of the powder grains is due to the graphite used in the process. The powder is quite stable over long periods, if kept dry.

While the black powder was being used, other explosive substances were also experimented with, to find if they could be used as propellants. Notable substances tried for the purpose were:—

(1) Potassium chlorate.

(2) Mercury fulminates.

(3) Ammonium nitrate.

The last, ammonium nitrate, in combination with sulphur and charcoal, was used just like the black powder. A mixture of ammonium nitrate, potassium nitrate and charcoal was also tried. Ammonium nitrate powders were highly hygroscopic and did not offer any advantage over the conventional black powder. They are not manufactured commercially, though ammonium nitrate mixtures are used as explosives for blasting purposes extensively.

2.2 Smokeless Powder

The era of modern high velocity ammunition started with smokeless powders in which nitroglycerine and nitrocellulose (gun cotton) are the propellants.

Nitroglycerine is obtained from glycerin by nitration with a mixture of sulphuric acid and nitric acid. It is a yellow oily liquid. It is extremely dangerous in pure form. Its modifications: dynamite, blasting gelatin, cordite and ballistite are well known. The first two are used in blasting. The last two are used in ammunition, which also contain nitrocellulose.

Nitroglycerine is not used alone in small arm ammunition.

Gun cotton or cellulose nitrate is obtained by nitration of cellulose with sulphuric acid and nitric acid mixture. The nitration is carried out under controlled conditions. When nitrogen content of the nitrated cellulose is about 13.0% (range 12.6 to 13.3%), the product is gun cotton, used in explosives and ammunition. One gram of nitrocellulose (12.75 % Nitrogen) gives 900 millilitres of gases on complete combustion. It is essential to remove the last traces of nitric acid from gun cotton. Otherwise, the product is unstable and undergoes decomposition, causing explosions.

Gun cotton is powdery and as such unsuitable for propellant purposes. It is gelatinised in suitable solvents (ether-alcohol mixture). The gelatinised mass is transformed into various nitrocellulose propellants. They are somewhat hygroscopic in nature. They are, therefore, coated with graphite or di-nitrotoluol. Graphite also prevents static charge development on the powder chips. The stability of the powders is increased by the addition of a small amount (0.6%) of diphenylamine. The stabilisation of cellulosic propellants is essential. Otherwise, nitrocellulose decomposes and gives off nitrogen dioxide and heat that deteriorate ammunition and may cause explosions.

Nitrocellulose propellants are insensitive to pressure. They develop comparatively less heat than nitroglycerine powders for the equivalent pressure. Thus, they are less detrimental to barrels.

When nitrocellulose is used alone, it is single base powder. When it is used in combination with nitroglycerine, it is double base powders.

The compositions of the common double base powders are:—

Table III-3

	Cordite	*Modified cordite*[1]	*Ballistite*
Nitroglycerine	58%	30%	100 Parts
Nitrocellulose	37%	65%	200 Parts
Mineral jelly[2]	5%	5%	

Smokeless powders are also described as:—

(1) Bulk powders.

(2) Dense powders.

(3) Progressive, degressive and constant-volume powders.

The bulk powders were created to continue to utilize the measures and the machinery used in the black powder ammunition manufacture. Bulk powders were fluffy and contained inactive materials, which increased their volume. Equal volumes of the bulk powder and black powder gave similar ballistics. They are no longer favoured.

Dense powders do not contain any volume increasing inactive materials. They are used in small arms. They require much less space in a cartridge case. The di-nitrotoluol coating on dense powders controls the initial burning in addition to preventing absorption of moisture.

In progressive powders, on burning, the gas pressure increases progressively inside the barrel. Consequently, the peak pressure developed is much less, than the one developed in other dense or bulk powders for achieving the same velocity for the projectile. The effect is achieved by designing the shape and size of the powder particles. The powder particles are porous.

Progressive powders are especially useful in long barrelled firearms. Dense or bulk powders flare up and give a 'big push' to the projectile creating high temperature and pressure. The projectile moves out of the barrel due to the initial 'push'. However, due to friction in the barrel, there is some loss of velocity. Progressive powders give sustained push. Thus, not only better velocities are achieved but also the temperature and pressure developed for the same velocities of the projectiles is substantially lower, increasing the life of the barrel.

Progressive powders can be tailor-made to suit the ballistics of a particular firearm by controlling shapes and the surface areas of the powders.

In degressive powders, the burning area of the propellant goes on decreasing. Consequently, the volume of gases produced, decreases continuously, decreasing the pressure on the projectiles. Degressive powders are used in short-barrelled firearms' ammunition to get the maximum push in one go.

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1. Commonly used in shotgun ammunition in India.
2. Numerous substances including acetone alcohol, have been used to improve the keeping quality of the propellant ethyl centralite is used as stabilizer when nitroglycerine is more than 20 per cent in double base powders.

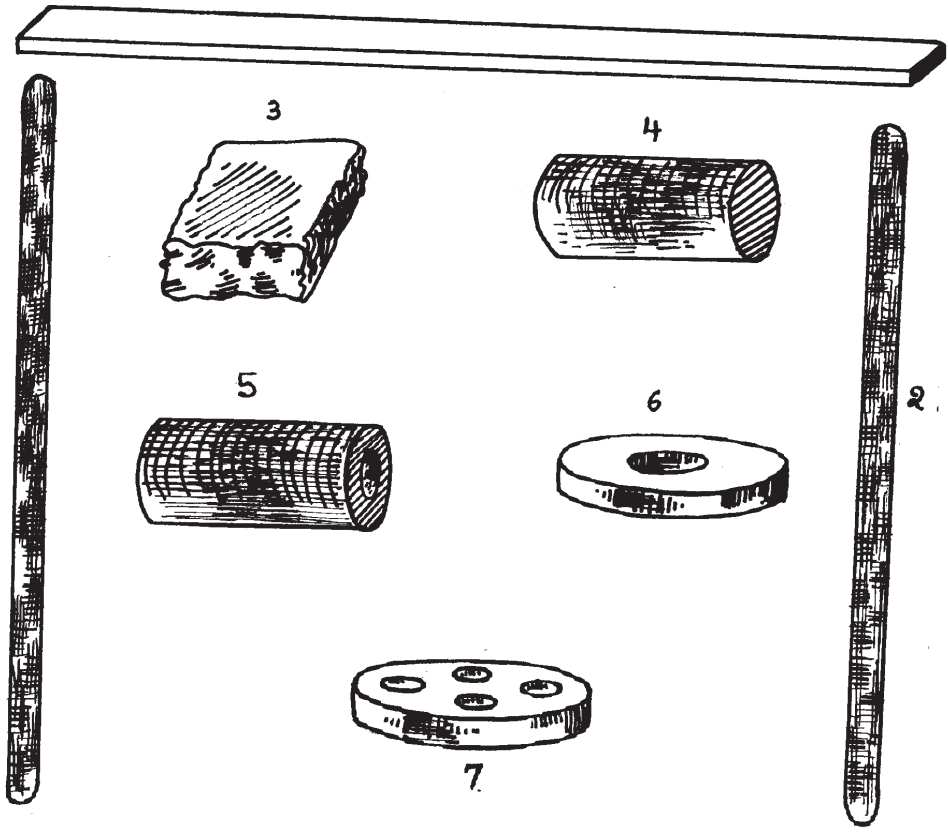


Fig. III -1

Shapes of Various Powders

(1) Strip, (2) rod, (3) flake, (4) cylinder, (5) tube, (6) perforated disc, (7) multiperforated disc.

Powders shaped like 1, 2, 3 and 4 burn with decreasing surface area. The volume of the gases produced, goes on decreasing. They are known as degressive powders.

Powders of shapes 5 and 6 burn without change in surface area. The volume of gases produced also remains constant while the powder lasts. They are known as neutral (constant volume) propellants.

Multi-perforation disc powders (7) are called progressive powders. The surface area as well as the volume of gases produced, goes on increasing as the burning proceeds. Progressive powders give higher velocity for the same maximum pressure, as compared to degressive on constant-volume powders.

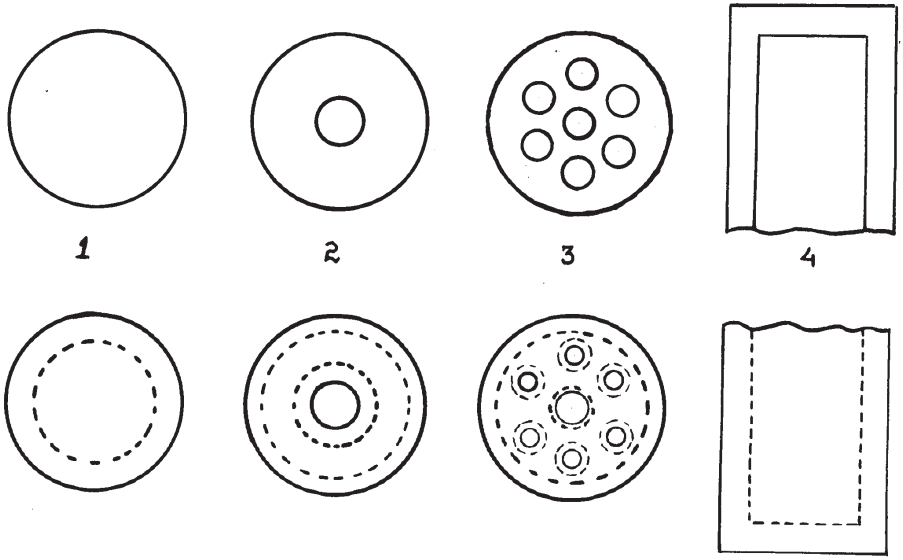


Fig. III -2

Burning of different varieties of powders

The upper figures represent the original shape of the powder. Lower figures represent the partially burnt stages. (1) cylinder or disc (degressive) powder, (2) tube (constant volume) powder, (3) multi-perforation (progressive) powder, (4) strip or flake (degressive) powder.

Smokeless powders deteriorate with time. However, the life span of smokeless powders has been increased tremendously in recent years by improved technology and by addition of stabilisers.

The deterioration of smokeless powders is due to the decomposition of nitro-cellulose, which gives oxides of nitrogen. These oxides adversely affect the cartridge cases and other components of the cartridge.

2.3 Semi-Smokeless Powder

Semi-smokeless powder is a mixture of black powder and nitrocellulose. The approximate composition of the powder is:—

Table III-4

Nitrated wood cellulose	= 20%
Potassium nitrate (KNO_3)	= 60%
Carbon (C)	= 12%
Sulphur (S)	= 8%

The mixing process is very dangerous.

Though some advantages have been claimed for the powder, the danger involved in its manufacture has prevented its extensive production and use.

An ideal powder has the following features:—

(1) It should be stable on storage.

(2) It should be non-corrosive.

(3) It should produce minimum amount of smoke.

(4) It should produce minimum heat for a given velocity.

(5) It should be homogeneous. Same amounts of the powder should give same velocities.

(6) It should be cost effective.

(7) Its manufacture, storage and use should be safe.

It is mainly to improve these qualities that most of the research in propellants goes on. Consequently, new propellants are always coming up in the market.

2.4 RDX Based Propellant

A new propellant in which the active ingredient is from the family of *cyclo-tri-methylene-tri-amines* (RDX) is being researched. It is being tested for the manufacture of caseless.

2.5 Triple-Base Powders

Triple-base powders contain the following ingredients:—

Table III-5

TRIPLE-BASE POWDERS

1. Nitroglycerine
2. Nitrocellulose
3. Black Powder

The percentages of the various constituents vary. These triple-base powders do not offer any special advantage. They are, therefore, have not reached the market.

3. PROJECTILES

Projectiles are pellets, buckshots, balls, flechettes, bullets, etc., intended to cause injuries. They are hurled out by gases produced by the propellants on discharge of a firearm. These projectiles vary in constructional materials, shapes and sizes and in their ballistics.

The projectiles have undergone the usual evolution. The first projectile for the firearm was probably a stone of convenient size. The next logical development probably was an imitation of an arrowhead. Ultimately, these initial projectiles gave way to spherical projectiles, which held the field for a long time. They continue to be used in smooth bore firearms. Research and experience indicated that the spherical projectiles are not efficient ballistically.

Lead, almost the original material used for the projectiles was found indispensable, though for high velocity projectiles it was covered with a harder metal jacket. The basic material of projectiles, however, continues to be lead, because:

1. It has high specific gravity.
2. It has low melting point. It can be moulded into various shapes easily.
3. It is comparatively cheap.

Lead in the pure state, is quite soft and is deformed easily. The metal, therefore, is used in alloy form. Antimony is the main alloying matter. The alloys are quite hard and they are used for low and medium velocities projectiles in India.

The following compositions are common:—

Table III-6

(A)	Lead (Pb)	90 to 98%	
	Tin (Sn)	2 to 10%	
(B)	Lead (Pb)	90%	
	Tin (Sn)	5%	
	Antimony (Sb)	5%	
(C)	Lead (Pb)	85%	(Common in India)
	Antimony (Sb)	15%	

Lead, as core material, has been replaced in some of the modern rifles though not completely. For example, in Russian rifles (AK 47 and AK 74), the main part of the core is made of steel but a small amount of lead is also part of the core. Other rifles structured on the Russian pattern have also similar core composition. Flechettes, arrow-like projectiles, and some pellets are also made of steel. Some pellets are made from bismuth and other materials.

Non-lead projectiles are not common in India.

3.1 Lead Bullets

The first projectile to be fired from a rifled firearm was made of lead. The lead bullets held the field until the induction of smokeless powder. The smokeless powder generated higher velocities and higher temperatures. Lead bullets, though made from hardened alloys, are deformed under the conditions. They therefore, were not used in high velocity or semi-automatic or automatic firearms.

The lead bullets are still used in some firearms (revolvers!) firing low or medium velocities.

3.2 Paper-Patch Bullet

The simplest material for the jacket was paper. Such bullets were known as paper-patch bullets. They were good. However, they left pieces of paper in the barrel, which fouled the barrel extensively and gave trouble in subsequent firing. The barrels had to be cleaned frequently. The paper-patch bullets did not continue for long.

3.3 Wire-Patch Bullet

A lead bullet encased tightly in a wire made of copper or some other material makes a wire-patch bullet. During flight, the wire unbound itself. Both range and aim were affected adversely. They were given up soon. Some interest in wire-patch bullets has been aroused recently. A wire net in the shape of a bullet is placed in a bullet mould and molten lead is poured into the mould. These bullets should prove efficient and cheap for low velocities projectiles. They are likely to suffer deformations at higher velocities and at higher temperatures

3.4 Gas-Check Bullet

The gas-checks bullets have hard metal covered base, which protect the lead bullet from hot gases. The cover is made of copper usually. The bullets functioned well with firearms firing ammunition of low or medium velocities.

The gas-check bullets are not encountered in India.

3.5 Electroplated Bullet

To prevent excessive deformation, lead bullets were electroplated with copper. However, the exercise did not give good results. They increased fouling of the barrel without reducing deformation of the bullets substantially. Some .22 bullet are still copper-plated.

3.6 Metal Cased Bullet

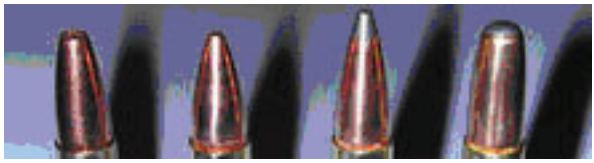


Fig. III -3

The modern bullet: left to right: hollow point, FMJBT soft point, round nose

Fig. III -4

Matchlock musket balls, allegedly found at Naseby battlefield

As seen above, lead bullets did not function properly at high velocities. They were deformed. Accuracy was adversely affected. Jacketted bullets were the outcome where the lead bullet was covered with a metallic jacket.

Previously, there were ample variations in the jacketting patterns of the projectiles. However, completely covering jackets are common in service rifle ammunition now.

The metal jackets almost fully overcame defects, which lead bullets suffered at high velocities.

The jackets vary in nature. They may cover the core completely, leave the nose exposed in soft nose and expanding bullets or leave the base exposed, as in most of the older military ammunition.

The material for jackets also varies. Copper, brass, mild steel, cupro-nickel alloy and gilding metal are commonly used. Cupro-nickel is the favoured material but gilding metal is cheaper. The former contains copper and nickel and the latter, copper and zinc.

The thickness of the jacket varies somewhat with different manufacturers and sometimes at various parts, to achieve special effects. Often it is around 0.5 mm.

In some cases, the jackets carry cannelures, which are filled with grease and cartridge case is crimped upon them. The grease lubricates the bullet and reduces friction, in its passage through the barrel.

In sporting rifle ammunition bullets with jackets, which expand and thereby increase the wounding effect, are preferred. It is not so for big game ammunition. Ordinarily, expanding bullets mushroom or break up after their entry into a body. The expansion causes great tissue damage. The various types of expanding bullets are:—

(1) **Dum-Dum bullets**: here the tip of the jacket was thinned by rubbing the tip.

(2) **Soft or silver point nose bullets**: here the tip of the bullet is made of softer material; brass and aluminum have been used.

(3) **Hollow point bullets**: they have hollow tips.

(4) **Pierced-point bullets**: they have linear cuts on the upper part of the jacket.

(5) **Belted bullets**: they have thinner jacket near the midpoint. The bullet breaks at this point on entering the target.

(6) **Hard-core Bullets**: here the cup of the jacket contains a hard metal insert, a piece of steel or bronze.

The Dum-Dum bullets were given the name because they were made at Dum-Dum, a place near Kolkata in India. The bullets were originally standard Mark VI .303 bullets. The British soldiers, who were fighting against Pathans, found that the bullets did not have sufficient stopping power. The soldiers rubbed the tips make them thin. On striking the target, these bullets with softened nose broke into many pieces and caused extensive injuries. They acquired tremendous stopping power and became popular. However, the use of the bullets was considered barbaric. The Hague Convention banned the bullets. However, the fancy name stuck in some countries, where expanding bullets were/are termed Dum-Dum bullets.

Soft-point bullets are jacketted but the tip (the nose) is soft: exposed, thinned, made of softer material, jacket bears linear cuts. Hollow point bullets also behave like soft nose bullets.

When the soft nose bullet strikes the target, it mushrooms into an umbrella-like formation and causes a wound much larger in diameter than the bullet itself.

Alternatively, when the velocity is high, the bullet fragments cause extensive wounds. Thus, the stopping power and the wounding effect of the shattered bullet are greatly increased.

The soft nose bullets are useful only for comparatively soft-targets. On tougher targets, they expand too soon. Consequently, the bullet may not penetrate and become ineffective. Hollow point, silver tipped and belted bullets do not give such changes. They exhibit both penetration and expansion.

In the hollow point bullets, the tip is hollow; the lead core does not fill the cone of the nose of the jacket. The bullet is excellent for aim accuracy and expansion.

The silver tip bullets have aluminum tips fitted in the tips of the jackets. The lightweight aluminum improves the aim and range of the projectile.

The pierced tip bullets have many linear cut at the tip of the jacket. The cuts promote better expansion of the projectile.

3.7 Non-Lead Bullet

The non-lead bullets were not common or popular, until recently. This was mainly because the sectional density, considered an important factor in ballistics, was adequate only with lead. France did experiment with copper-zinc alloy bullets. It was called *Balle D*. It was not much of a success. Now, steel is being used increasingly as bullet material, either alone or in combination with lead. Bismuth and spent uranium are being used for pellets. The flechettes, the arrow-like projectiles for shotguns are made of steel. Copper is also being used for bullets.

3.8 Armour Piercing Bullet

Basically, an armour-piercing bullet consists of a hard tungsten-chrome steel core point at one end. It is enclosed in a mild steel jacket, which has some empty space between the core and the jacket. The space is filled with a special filler alloy. On striking the target, the jacket and the filler create enough heat to soften the target material sufficiently to allow the core to enter into the target.

3.9 Tracer Bullet

The tracer bullets trace their trajectories, the path of flight. Some start tracing the path after traversing a distance of about 100 metres. The trace is visible in the form of a streak of bright red flame given by a special composition (Barium peroxide and magnesium powder) placed in the base of the bullet made hollow for the purpose. The bullet and other components of the cartridge are made to conform to the actual standard ammunition for which the trajectory is being observed.

The tracer ammunition is used to study the trajectories of standard ammunition. Theoretical considerations indicate that the results are approximate only.

The tracer ammunition is available for machine guns, rifles and pistols. The cartridges are extremely dangerous and their dismantling is still more dangerous. They often start fire if they strike or fall upon a combustible target.

3.10 Incendiary Bullet

The incendiary bullets start fire on striking the target. The ammunition is extremely dangerous and needs extreme care in handling.

3.11 Boat-Tailed Bullet

Boat-tailed bullets have tapered base end. The conidial bullets were found to create substantial air resistance at higher velocities. Tapering (or boat-tailing) helped the flow of air over the bullet and reduced the air resistance.

The boat-tailing of the bullets improves the aim and the range of the projectiles considerably. The tapering is limited to about the calibre length of the bullet to ensure better grooves grip of the bullet while rotating in the barrel rotation. About 9° slant of the taper is adequate.

3.12 Streamlined Bullet

Streamlined bullets have tapering to pencil points at both the ends. The nose-side point helped smooth penetration of the air and the base-side point provided a smooth sliding surface for the air to flow over the bullet. Theoretically, such bullets should have better aim and range. However, in practice, they did not do so.

These bullets require rigid constructional controls. The longitudinal axis must coincide with the line joining the ends. Besides, the centre of gravity must coincide with the centre of form (shape). If these aspects are not achieved, wobbling of the bullet will upset both the aim and the range of the projectile. The strict geometrical and constructional controls have stood in the way of its adoption on a mass scale. Besides, the projectiles are too symmetrical to deform and to transfer its energy to the target to cause effective wounding effect.

The streamlined bullets, therefore, are not used.

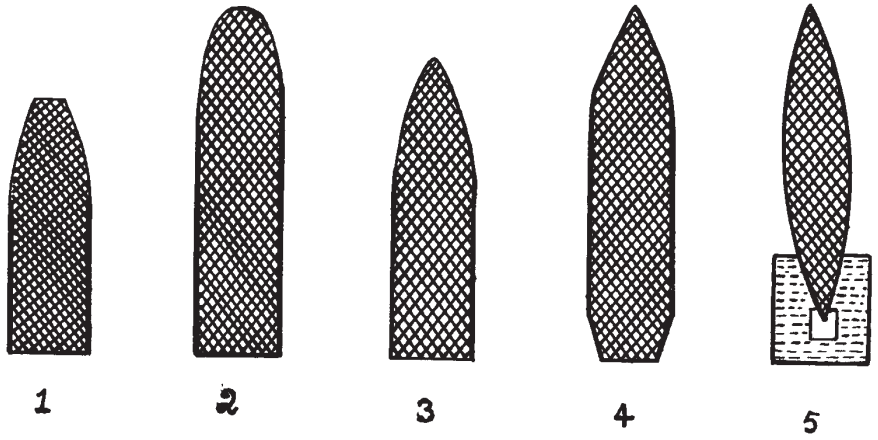


Fig. III-5

Important Bullet Shapes

(1) flat nose, (2) blunt nose, (3) cylindro-conoidal (standard), (4) boat-tailed, (5) stream-lined (with sabot).

3.13 Spherical Projectiles

The spherical projectiles are still extensively used in shotguns, muskets, pest guns and other short-range firearms. The shotgun is the principal weapon using spherical projectiles.

The spherical projectiles are made from hardened lead alloy (Lead + Antimony). They are used as single projectiles, as balls or slugs, or in larger numbers, in buckshot or pellet charges. The number of the pellets in a single cartridge can be over a thousand in some cartridges.

The balls, slugs and buckshots are cast in moulds. The molten lead is poured into the moulds. On cooling, the rough balls and buckshots are obtained. They are rumbled in barrels until the surfaces of the spheres become smooth.

The manufacture of the pellets is different. Molten lead alloy is dropped through sieves from a height of about 50 to 75 metres in towers. A blast of cold air is sent upward in the tower. The pellets are formed during the fall. They drop down in a water tank kept at the base of the tower. They are collected, rumbled and graded.

The copper and nickel-plated pellets have also been used on experimental basis. They have not found favour on any extensive scale. Recently steel pellets are being used for specific use.

Spherical projectiles are also made from a lead alloy wire. The wire of appropriate size are cut into lengths of desired size and fed into dies. The dies compress and mould the slugs into spherical projectiles.

The pellets other than lead or lead alloys are rare in India. But in some countries the following types of pellets are also manufactured to overcome legal restriction for using the lead pellets for certain games. In India, there is no such restriction so far.

The smooth bore firearm use the following types of projectiles projectiles can be divided into three categories:—

1. Pellets
2. Buckshots
3. Ball
4. Slugs

The cartridges bearing numbers 1 to 9 carry pellet charge. As the number increases the number of pellets also increases and the pellets size decreases. The buckshot cartridges carry alphabetic lettering. Thus, we have LG, SG, etc. (Table III-16)

The pellet charge is suitable for small bird game. The buckshot charge is used for bigger games.

In ball ammunition, the projectile is exposed in the cartridge at the top end.

Ballistically the spherical projectiles of smoothbores are inefficient for long ranges. Yet the shotgun is a popular firearm. Following innovations have come up to increase the aim and range:

(1) *The Paradox projectile* is a specially made bullet, (almost conical) intended to be fired from a paradox shotgun, which has two shallow grooves

near the muzzle end. Spin the paradox projectile while passing through them. Both the aim and the range are improved considerably.

(2) *The Rotary projectiles* are varied structures but all ensure spinning as they move along the barrel. The projectile continues to spin in its trajectory. The spin improves both the aim and the range of the shot.

The gyration of the projectile is achieved by special construction of the projectiles. They are Rotary projectile has a hollow cylinder with fin-like twisted projections either on the inside or outside of the surface. The gases of combustion exert pressure on these fins and rotate the projectile.

(3) *The Split balls* and buckshot packed in a spherical or cylindrical container are also used to increase the wounding effect of the ball ammunition.

The spherical lead balls have slightly less diameter than the bore diameter of the barrel from which they are fired.

Table III-7

BARREL-BORE-BALL SIZE

Bore		10	12	16	20	24
Barrel diameter	mm.	19.69	18.52	16.81	15.62	13.97
	Inches	0.775	0.729	0.662	0.615	0.550
Ball Diameter	inches	0.710	0.645	0.610	0.545	0.542
	mm.	18.03	16.38	15.49	13.84	13.76
Ball weight	grains	570	412	342	246	238
	gm.	28.60	26.70	22.16	15.94	15.42

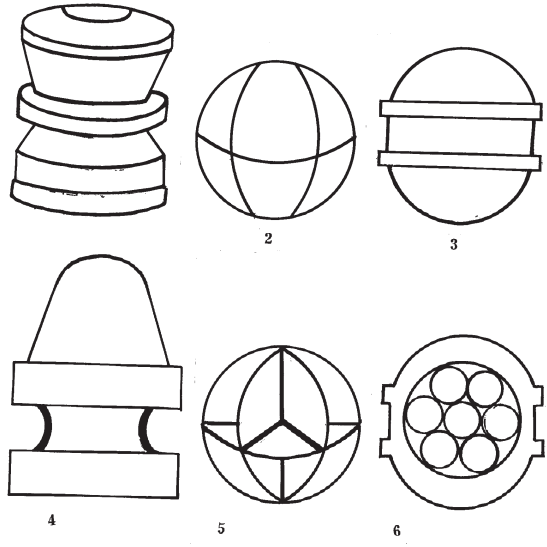


Fig. III-6
Ball Ammunition

1. Rotax : The gases produced in cartridge press against the twisted ridges inside and rotate the projectile.

2. Expansive ball, belted: It fragments on hitting the target. The sectioned ball is shown in (5).

3. Multi-shot ball : It is a lead ball containing lead shots. The sectioned view is shown in (6).

4. Paradox projectile : It is fired from paradox guns which have shallow grooves near the muzzle end.

4. PRIMERS

The development of the cap composition had been a fascinating and dangerous adventure. It has been one of the most important steps in the development of firearms. It gave a final blow to the matchlock, flintlock and wheel lock ignition mechanisms. It also gave an all weather cartridge.

4.1 Prime compositions

The primer composition has the following basic ingredients:—

1. An initiator, a sensitive high explosive,
2. Fuel,
3. Oxidiser,
4. Stabiliser.

Mercury fulminate was the first important initiating explosive used in primers. It gives out a flame when struck and ignites antimony sulphide (a combustible material). Potassium chlorate supplies oxygen to ensure proper ignition.

The composition of a mercury fulminate primer (by weight) is given in the table below:—

Table III-8

Mercury fulminate [$Hg(ONC)_2$]	= 8 parts
Potassium chlorate: ($KCLO_3$)	= 14 parts
Antimony sulphide: (Sb_2S_3)	= 18 parts
Sulphur (S)	= 1 part
Gunpowder:	= 1 part

The composition varies somewhat with different manufacturers. Powdered glass is also used in place of sulphur.

Mercury fulminate primer suffers from a number of drawbacks:—

(1) Mercury fulminate gives mercury on ignition. It makes the brass cases brittle and consequently unfit for reuse. It is somewhat unstable also.

(2) Mercury is deposited in the barrels, and damages the barrel.

(3) Potassium chlorate, on ignition, deposits potassium chloride in the barrels. This salt absorbs moisture and speeds up rusting and fouling of the barrel. In fact, potassium chloride is the most troublesome constituent of the residue. It reduces barrel life considerably. Potassium chloride is easily removed by washing the barrel with hot water. Techniques other than washing do not remove the salt completely.

(4) Powder glass particles abrade the barrel during their passage and reduce the life of the barrel. There is an increase in bore diameter.

In view of the above, new primer compositions have come up. The following two may be mentioned which are relatively free from the above defects.

Table III-9

(1) Lead styphnate,
(2) Barium nitrate,
(3) Lead peroxide,
(4) Tetracene.

Table III-10

(1) Lead trinitroresorcinate,
(2) Tetracene,
(3) Antimony sulphide or calcium silicide,
(4) Lead nitrate or potassium nitrate.

In India the new primer composition, being used is in the table below:—

Table III-11

(1) Lead styphnate	=	32-42 %
(2) Antimony sulphide	=	13-17 %.
(3) Barium nitrate	=	27-37 %
(4) PETN	=	4-6%
(5) Tetracene	=	3-5%
(6) Aluminum	=	6-8%

Sinoxid, a primer composition, extensively used in USA, has the ingredients given in the table:—

Table III-12

(1) Lead styphnate	=	40 %
(2) Antimony sulphide	=	10%.
(3) Barium nitrate	=	42%
(4) Tetracene	=	10%
(5) Nitro-cellulose	=	6%

An improved primer composition being considered in USA, contains titanium and zinc salts and tends to eliminate lead salts.

In Europe, a useful primer composition has the composition given the table below:—

Table III-13

Pyrophoric mixture of metals: (magnesium 20%		
Cerium 5%, Lanthanum 4%, Rare earth 3%, iron 7%)	=	50%
Barium nitrate	=	20%
Lead dioxide	=	10%
Zirconium powder	=	20%

Some .22 rim-fired cartridges contain only lead azide [$Pb(N3)_2$] as initiator in their primer charge.

In military ammunition, the primer composition used to contain mercury fulminate as the main ingredient. It is being replaced by lead styphnate in most of the countries.

The primer compositions mentioned above are used in all systems of ignition, namely in rim-fire, pin-fire and centre-fire cartridges, all over the world with minor modification here and there.

Originally, the primer composition was placed in paper strips (like the shot strips in toy pistols) and fed over to the flash hole of a gun where it was struck to give out a flame and ignite the powder charge. Paper pellet primers later gave way to metallic cup percussion caps, which are being used in all centre-fire ammunition.

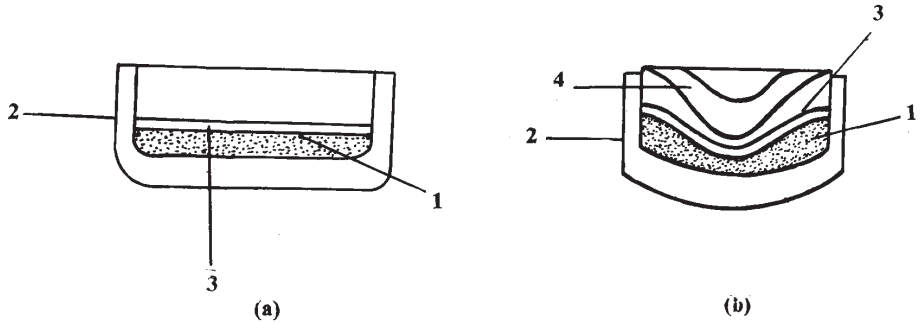


Fig. III-7

Percussion Caps

(a) Berdan primer, (b) Boxer primer

(1) cap composition, (2) case, (3) protective strip, (4) anvil.

The percussion cap cups are manufactured from a sheet of copper, brass, cupro-nickel alloy or of gilding metal of appropriate thickness. The discs of required diameter are cut, cleaned, stamped, drawn into cups and assembled on a steel plate. The primer mixture in the form of wet dough is charged in these cups (the mixture is handled wet throughout the operations). The cups are dried in special ovens, and covered with lacquered tin foil. The anvil in Berdan percussion caps is provided by the case. In Boxer percussion caps, an anvil in the form of a metal strip shaped into 'V' is introduced in the cup while the mixture is still wet.

The percussion caps are manufactured in two diameters: 5.3 mm (= 0.210″) and 4.3 mm (= 0.175″). The former has three varieties: for high velocity rifle ammunition, for medium velocity rifle ammunition and for heavy pistol and revolver cartridges. The latter is available in two types: one for small calibre rifles and the other for light pistols and revolvers. The charge for the former is about 40 mg (= 0.6 grain). It is slightly less in the smaller percussion caps.

The percussion cap is dangerous because the primer mixture is very sensitive to heat, pressure, impact and friction. It can cause accidents. Nobody should fiddle with live percussion caps.

Percussion caps are difficult to deactivate except through firing. The lacquer layer over the primer mixture protects the mixture. Prolonged action of water or thin oil (soaking the caps in them) may deactivate them.

The rim-fire cartridges do not have separate percussion caps. The primer mixture is contained in the rim. The mixture explodes when the firing pin hits and compresses the mixture in between the sides.

In shotguns, the Boxer type of percussion caps is used. They have longer (deeper) cups.

5. CARTRIDGE CASES, SHELLS

The cartridge cases or the shells house the primer, the propellant, the wads, if any, and the projectile charge. They are manufactured from a variety of materials: brass, paper, aluminum, steel and plastics are currently being used. The paper cartridge cases with brass base are commonly used in India, for shotgun cartridges. The Indian Ordnance Factories have also started manufacturing cartridge cases with plastic tubes. In USA, plastic shells have replaced the paper shells, almost completely, though the brass base for the shell continues. The brass shells for rifle, pistol and revolver ammunition are, by far, the commonest. It is believed that plastics and aluminum will find ever-increasing use for the shell manufacture as long as the caseless cartridge does not displace the other cartridges.

From the practical point of view, only two types of cartridge cases are important in our country, at present. They are reviewed here, briefly.

5.1 Shotgun Shell

A shotgun shell consists of a tube, a base and a base wad. The tube is ordinarily made of many layers of impregnated thin paper, which are tightly compressed. The ultimate tube is sufficiently strong to withstand the pressure (800 kg/cm^2), developed in the cartridge. It is also made waterproof.

The shotgun shells are usually made into two lengths:—

1. 2.5″ (= 63.5 mm)
2. 2.75″ (= 70 mm)

The base is made of brass. The process of manufacturing the brass bases (cartridge head) is similar to the one used for the manufacture of percussion caps or brass shells. The base wad is made of many layers of paper. The brass base, base wad and the tube are placed together in a die and crimped together to create a rim, which holds them together. The rim of the brass head ensures proper hold of the base wad and the paper tube. The hold is strengthened additionally sometimes by circular grooves around the tubular portion of the brass head. The rim also retains the cartridge in the chamber properly.

The base wad strengthens the cartridge cases. It also serves as filler in dense powder ammunition. Sometimes a circular steel strip is put in between the base wad and the brass head for additional strengthening of the system.

Other information about shotgun shells, which may be useful, is:—

1. There are low and high brass bases. In India, usually low brass bases are used. High brass bases are met with in Magnum cartridges with larger powder and projectile charge. They may or may not have higher velocities.
2. If the cushion wad does not seal the barrel, part of the gases escapes and heat up the pellets to melt and fuse them. These molten projectiles would not give the intended ballistics.
3. The projectiles, which come in contact with the barrel, may be deformed due to friction and pressure. They may go astray in their flight, once they are out of the barrel.
4. Over-shot wads interfere a little with the dispersion of the pellets by getting into their way after it had come out of the barrel.

5.2 Brass Shell

Brass (copper 70%, zinc 30%) is a good alloy for the manufacture of shells. It is the main material used in the manufacture of shells for rifles, pistols and revolvers ammunition on a large scale. This is because the alloy is easy to work with: stamped, drawn and annealed. Besides, it is resistant to corrosion and action of weather. It has sufficient elasticity to fill the chamber under pressure (obturation) and come back to original size after the pressure is released. Brass of high quality and purity only is used for the purpose.

The brass shells are manufactured by automatic process involving about two scores of operations. It starts with a sheet of brass of appropriate thickness. A disc of desired diameter is punched out. The disc is stamped to give a shell after a number of stamping, heating, annealing and drawing operations.

The cartridge cases may be rimmed, semi-rimmed, rimless or belted. They may be straight, tapered or bottlenecked.

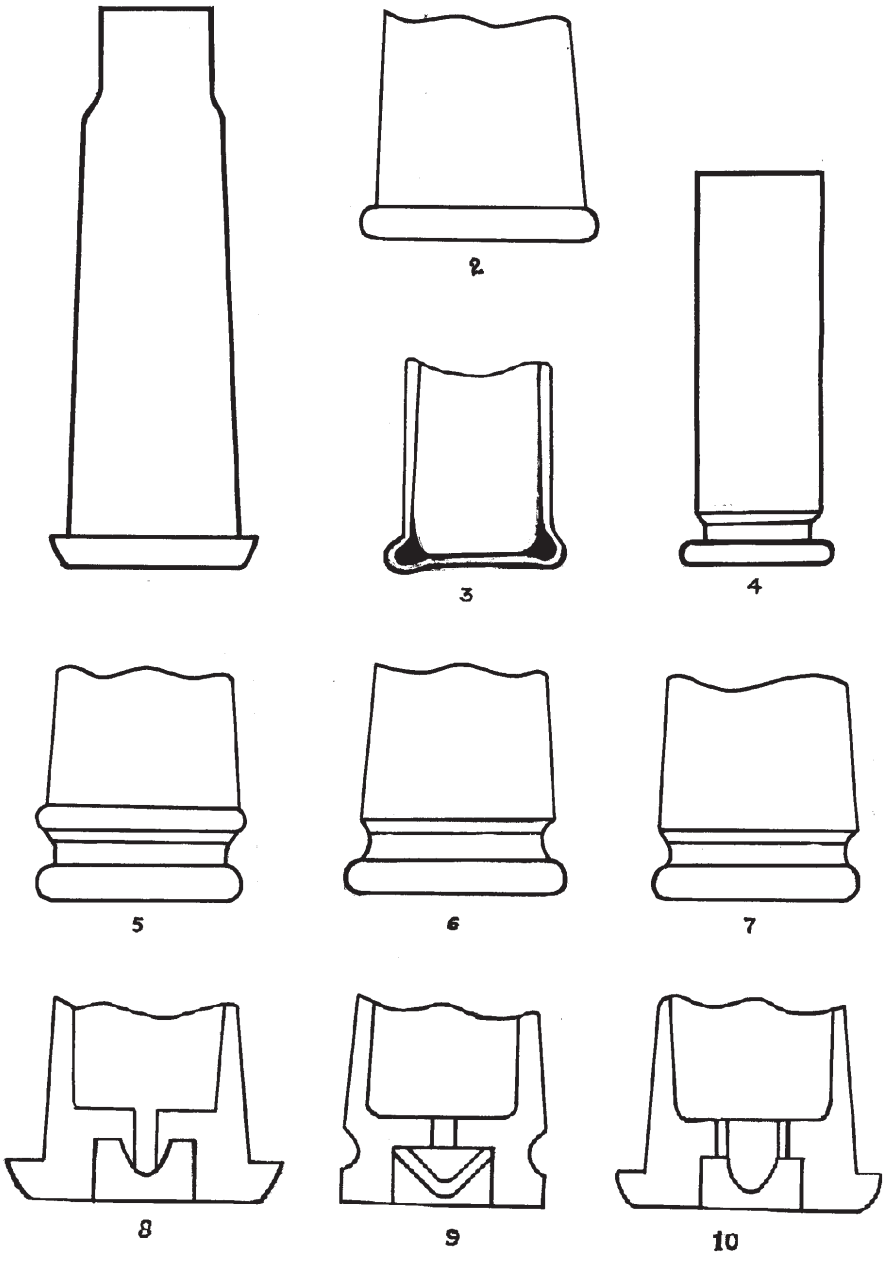


Fig. III-8

Cartridge Cases

(1) bottle-necked rimmed case; (2) tapering rimmed case; (3) rim-fire case; (4) cylindrical case; (5) belted case; (6) semi-rimmed case; (7) rimless case; (8) anvil part of the case with single flash hole; (9) anvil part of the percussion cap; (10) anvil part of the case with two flash holes. (Figures 8, 9 and 10 are sectioned view of the cartridge cases).

6. WADS

In shotgun ammunition, there are a number of wads. Over-powder wad, cushion-wad, under-shot wad and over-shot wad. They keep the charges in the cartridge in their proper places. In addition, the cushion wads seal the barrel on firing and thus prevent escape of gases and consequent loss of velocity. They also clean and lubricate the barrels.

Over-powder, under-shot and over-shot wads are made of special quality cardboards varying in thickness from about 2 to 3.5 mm. They are waterproof. They are slightly larger than the bore of the firearm for which they are intended.

Table III-14

WAD DIAMETERS OF VARIOUS SHOTGUN AMMUNITION

Bore		10	12	16	20	24
Bore diameter	inches	0.775	0.729	0.662	0.615	0.550
	mm	19.7	18.5	16.8	15.6	14.0
Wad diameter	inches	0.784	0.738	0.671	0.623	0.557
	mm.	19.9	18.7	17.0	15.8	14.1

Cushion wads are made from felt, cork, feltine (shredded paper), cardboard or from plastics (with air holes). They seal the barrel properly and prevent escape of gases.

The cushion wads are about 12.5 mm thick and are often greased. The grease lubricates the barrels.

The modern shotgun wadding has undergone a sea change in the last few decades:—

1. The base wad is a plastic mould and fixed in the base of the brass head, under pressure.
2. The over-powder wad has changed to an inverted cup wad—open side towards (and over) the powder, so that when gases are formed, the lip, the open round edge of the cup, is pressed with the pressure against the barrel and thus it seals the bore. It prevents the escape of gases from the sides.
3. The cup wad and a 'piston', which is attached to the rectangular projectile sleeve containing and protecting the projectiles, also acts as cushion wad. The sleeve has cuts along the edges in frontal part of the sleeve. The four sides of the sleeve open up and fan out along the cuts, when the sleeve comes out of the muzzle. The sleeve is separated from the projectile charge. The sleeve being lighter falls down. It does not interference with the shots, in their flights.
4. The buckshots in a cartridge have spaces, which are filled with granular plastic material to cushion the buckshots. The plastic grains prevent damage to the buckshots and provides uniform push to the projectiles. The arrangement gives better spread and uniform velocities to the buckshots.

The above innovations have improved the aim, range and ballistics of the shotgun cartridge considerably.

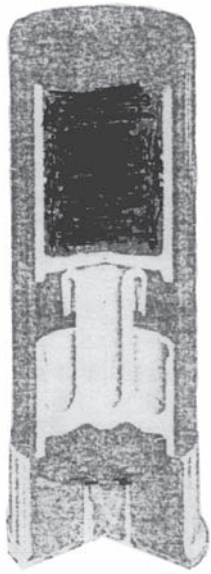


Fig. III-9

Sectioned view of a modern cartridge wadding. The white outtline represents plastic cup, piston and sleeve.

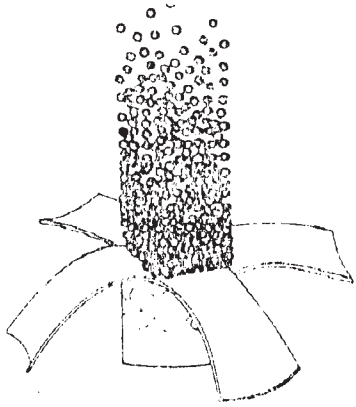


Fig. III-10

Pellet protection sleeve opening up on firing.

Indian Ordnance Factory has introduced similar wads in their cartridges.

In rifle, pistol and revolver ammunition, ordinarily, no wad is used, but in some cases, a small wad over the powder charge is provided. It separates the powder charge from the projectile. It prevents the lubricating grease placed in the cannelure to seep inside and spoil the powder charge.

7. LUBRICANTS

Bullets are lubricated to reduce friction and prevent oxidation of the cases or projectiles. Formerly, external lubrication or internal lubrication was used. In the former, the bullets were covered with a layer of bees-wax. These bullets tended to collect sand, dust and dirt. The technique is not favoured now. In internal lubrication, bees-wax was placed in the cannelures of the bullet. The cannelures were covered in the cartridge case.

Jacketted bullets ordinarily do not have any lubricant.

8. FIXED AMMUNITION – CARTRIDGES

The first cartridge developed in the sixteenth century, had powder and projectile (balls or buckshot) contained in a paper packet. The contents of the packet were introduced into the firearm from the muzzle end, after opening the packet. Various devices, as discussed above, ignited the powder. With the development of the primer, fixed ammunition for all firearms became common.

The nomenclature of the cartridges varies. The cartridges are named according to the way in which they are fired. Thus, we have pin-fire, rim-fire and centre-fire cartridges.

1. The *pin-fire* cartridges are now obsolete. They had a pin which with one end protruding out of the cartridge. The second end of the pin was located close to the primer mixture inside, quite close to the powder charge. When the pin was ignite struck, the primer mixture would ignite and set the propellant on fire. The pin-fire cartridges were forerunners of the centre-fire or rim-fire cartridges.
2. The *rim-fire* cartridges are used in small-bore rifles only, particularly in 5.5 mm calibre (= 0.22″) rifles and pistols. The striker compresses the primer mixture in the fold of the rim. It gives out a flame, which initiates the combustion of the propellants placed along.
3. The *centre fire* cartridges are used in most of the small firearm ammunition today. The percussion cap, containing the cap composition, is fitted in the base of the case. The primer mixture explodes when the firing pin strikes it. The heat/flame generated puts the powder charge on fire.

8.1 Shotgun Cartridge

A shotgun cartridge (round) has the following main components:

1. A case fitted with a percussion cap,
2. Powder charge,
3. Projectile charge,
4. Wads.

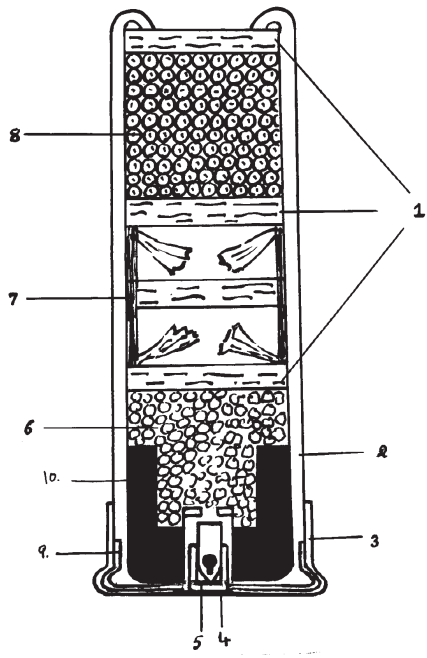


Fig. III-11

Sectioned View of a 12-Bore Cartridge

(1) wads; (2) cartridge case; (3) brass base; (4) percussion cap; (5) cap composition, touching anvil; (6) propellant; (7) cushion wad; (8) pellets; (9) steel strip; (10) base wad.

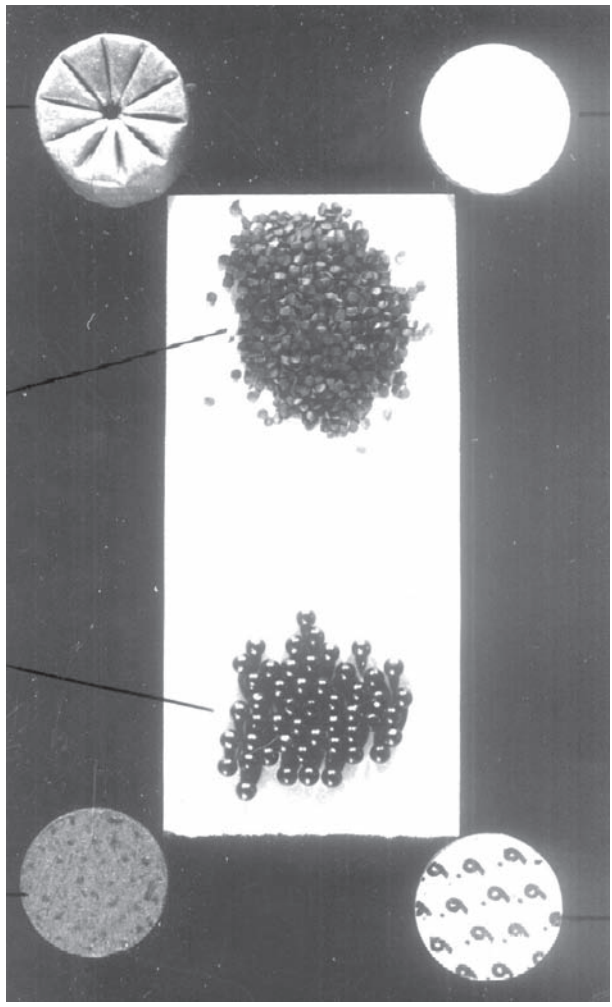


Fig. III-12

Components of a 12-Bore Cartridge (Indian Ordnance)

(1) over-powder wad, (2) over-shot wad, (3) under-shot wad, (4) cushion wad, (5) powder charge (not whole), (6) pellets, No. 6 (not all).

The shotgun cartridge is filled with an appropriate amount of bulk or dense powder, equivalent to 3 drams of black powder (which weighs 33 grains or 2.7 gm.). The powder is covered with a thin compressed over-powder wad. A cushion wad is placed over the over-powder wad. Another wad is places over the cushion wad. Shot charge is placed over this wad. An overshot wad covers the projectile charge and the cartridge is closed by crimping.

In a 12-bore shotgun cartridge, the quantities of the shots vary, from 28.35 gm. (1 ounce) to about 35 gm. (1.25 ounces), in India. The number and size of projectile shots also vary. The following tables (III-15 and III-16) give the data.

Table III-15

SHOT SIZES-NUMBERS IN DIFFERENT COUNTRIES PER 30 GRAMS

Size	*American*	*Belgian*	*British**	*French*	*German*	*Italian*
1	77	111	107	79	80	85
2	93	131	128	91	97	103
3	114	150	150	106	120	128
4	143	185	182	121	149	187
5	182	233	235	182	196	235
6	235	289	289	236	247	289
7	316	364	364	278	330	364
8	432	482	482	430	452	482
9	617	621	621	728	643	621
10	918	910	910	1030	960	910

* The British sizes are used in India.

The British shot size nomenclature is used in India.

Table III-16

PROJECTILE CHARGES OF CARTRIDGES

S.N.	*Number*	*No. of pellets per 28.35 gm.*	*Diameter of pellet in mm.*	*Weight of one pellet (in gm.)*
1.	LG	6	9.14	4.73
2.	SG	8	8.43	3.54
3.	Special SG	11	7.57	2.58
4.	SSG	15	6.83	1.89
5.	AAA	35	5.16	0.81
6.	A	50	4.57	0.57
7.	BB	70	4.09	0.41
8.	B	80	3.90	0.35
9.	1	100	3.63	0.28
10.	2	120	3.41	0.24
11.	3	140	3.25	0.20
12.	4	170	3.05	0.17
13.	5	220	2.79	0.13
14.	6	270	2.59	0.11
15.	7	340	2.41	0.08
16.	8	450	2.21	0.06
17.	9	580	2.03	0.05
18.	Dust	2770	1.22	0.01

Table III-17

SHOT SIZES/WEIGHT IN 12-BORE 70 MM CARTRIDGE IN USA

No.	*No. of shots*	*Diameter (mm)*	*Weight (g.)*
000	8	9.14	4.44
00	9	8.38	3.42
0	12	8.13	3.12
1	71	4.06	0.41
2	86	3.78	0.34
3	106	3.53	0.27
4	132	3.33	0.21

The closing of the cartridge is done in a number of ways. After the various wads and other components are placed in position in a cartridge case, the remaining portion (edge) of the case is turned over. The turnover is, ordinarily, sufficiently tight to prevent rattling of the shots inside. Besides, it does not 'open up' until there is sufficient pressure inside (about 4 Kg/cm^2).

Shotgun cartridges are also closed by crimping. It keeps the contents of the cartridge in position and the cartridge 'opens up' only when adequate pressure is developed, after firing.

Crimping was originally used in metal cartridge cases. Now it has also been introduced in paper tube and plastic shell cartridges also. In fact, in USA, now crimping is used to close the shot shells.

Flechettes

A new type of projectile system has also come—Flechette-Sabot system for shotgun ammunition. It fires steel arrows instead of buckshots, fixed on to a sabot. There are no other changes in the cartridge. The specifications for the cartridge are:—

Table III-18

FLECHETTE 12-BORE SHOTGUN CARTRIDGE

Cartridge Length	=	75 cm
Projectile Weight	=	2 g
Projectile Material	=	steel
No. of Projectiles	=	20

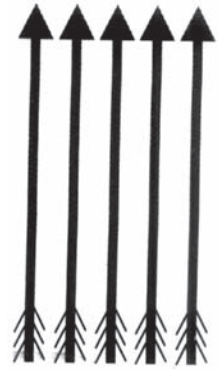


Fig. III-13 *Schematic Diagram of Flechettes*

It is claimed that the flechette cartridge is more efficient than a buckshot cartridge and that they do not damage the barrel. This type of cartridge is not used in India so far, as far as the author knows.

8.2 Rifle Cartridge

Rifle cartridges vary tremendously. The most evident variation is in calibre of the firearm, which is also the rough indicator of the diameter of the projectile in the cartridge. The designation of the calibre is only nominal. The actual diameter of the projectile varies somewhat from the designated calibre.

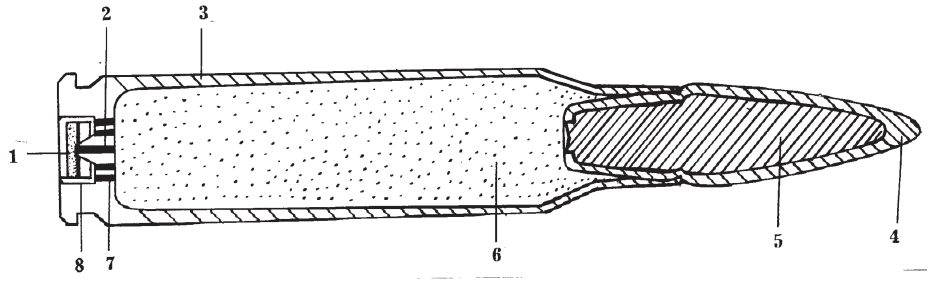


Fig. III-14

Sectioned View of a Modern Self-loading Rifle Cartridge

(1) cap composition, (2) anvil, (3) cartridge case (brass), (4) copper or cupro-nickel jacket, (5) lead core of a boat-tailed bullet, (6) powder charge, (7) flash holes, (8) percussion cap.

The rifle cartridges are known according to constructional feature of the shell of the cartridges. Thus, we have *rimmed, semi-rimmed, rimless* or *belted* cartridge[1]:—

1. The *rimmed* cartridges have a protrusion of the shell base beyond the tubular circle of the shell. The rim prevents the shell to slip into the chamber and helps the extraction process through extraction claw. It is used in non-automatic firearms.
2. The *rimless* cartridges have the same base diameter as the cartridge case. They are used in automatic and semi-automatic firearms. The absence of the rim helps better movement of the cartridges in the magazine and in the firing mechanism.
3. The *semi-rimmed* cartridges has a structure which is midway between the above two types. It has only a slight protrusion of the base as rim.
4. The *belted* and the semi-rimmed cartridges are innovations in the manufacture of the cartridges to make use of the same cartridge in the automatic semi-automatic or non-automatic weapons. In belted cartridge, the shell has some bulge to prevent its slippage into the chamber.

1. See fig….(III-8)

Table III-19

7.62 SERVICE RIFLE CARTRIDGE DATA

1.	Designation	=	7.62 x 51 mm
2.	Calibre	=	7.62
3.	Weight of the cartridge ~	=	23.15 g
4.	Weight of the bullet ~	=	9.35 g
5.	Powder charge	=	Nitrocellulose
6.	Observed velocity (at 28 ms)	=	825 m/s
7.	Length of the cartridge	=	5.118 cm.
8.	Length of the bullet	=	2.94 cm.
9.	Diameter of the bullet	=	7.836 mm.
10.	Angle of the boat-tail	=	9°

Table III-20

5.56 NEW SERVICE RIFLE CARTRIDGE INSAS DATA

1.	Cartridge:	
	Length	60 mm
	Weight	12.95 g
	Propellant	1.65 g
2.	Bullet:	
	Length	24.5 mm
	Weight	4.16 g
	Muzzle velocity	954 m/s
	Velocity (at 25 m)	890 ± 10 m/s

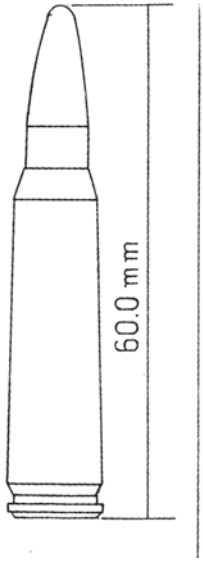


Fig. III-15(i)
Complete round

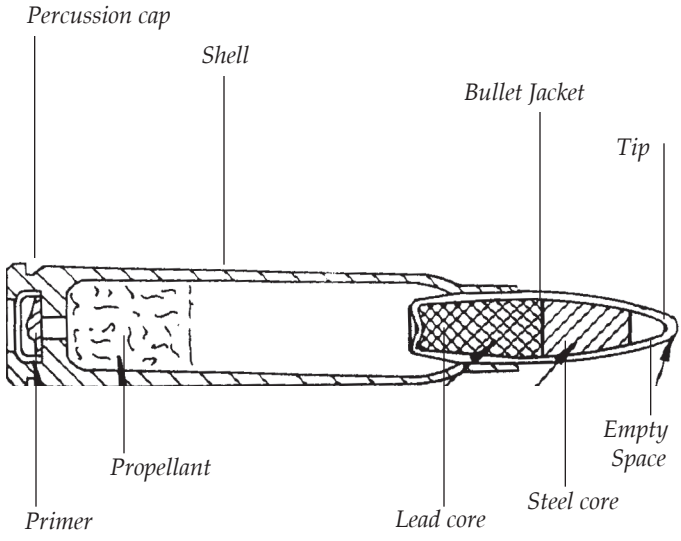


Fig. III-15(ii)
5.56 mm Insas Cartridge

The cartridges are sometimes known according to the velocities or power of their projectiles. Thus, we have 'high intensity' cartridges having velocities of over 800 metres per second (2700 f/s), 'high power' cartridges having velocities 600 to 800 m/s (2000 to 2500 f/s) and low power cartridges having velocities about 400 m/s (1200 f/s) or less.

8.3 Revolver Cartridge

Revolver cartridges are ordinarily centre-fire cartridges having a cylindrical rimmed case. The bullets are of lead alloy (lead and tin in the ratio of 12:1 or lead alloy containing one per cent. antimony). They are in some cases, jacketted. They have a round nose and a hollow base. There are cannelures on the bullets, which are filled with beeswax for lubrication purposes. Quick burning propellants are used in their manufacture.

8.4 Pistol Cartridge

The pistol ammunition is similar to revolver ammunition. It has two main points of differences. The pistol bullets are ordinarily jacketted. Some manufacturers also make jacketted bullets for revolvers. The ballistics is similar. Second, cartridge cases are rimless in pistols and rimmed in revolvers.

Table III-21

9 MM PISTOL CARTRIDGE 10F

Cartridge	
Length	29.67/ 28.91 mm
Weight	11.94 ± 0.65 g
Propellant	.38 to .45 g
Bullet	
Bullet Diameter	**.9.01/ 8.99 mm**
Weight	7.45 ± .13 g
Velocity at 18 m	397 ± 15 m/s

8.5 Blank Cartridge

Blank ammunition is intended to create noise, with complete safety. The cartridges contain no bullet or other material, which might act as a projectile.

Blank cartridges are manufactured for all types of small arms. Normal empty cartridge case is fitted with a suitable amount of quick burning powder charge and covered with a weak pulverisable wad. The mouth of the case is crimped.

Sometimes 'blank' cartridges are fitted with plastic bullets, which disintegrate within a range of 15 metres.

8.6 Rifle Grenade Cartridge

The manufacture of rifle grenade cartridge fired from .303 (or other calibre) rifle is similar to ordinary or blank cartridges. The essential differences are:—

1. The over-powder wad is cup-shaped. It prevents escape of gases by sealing the barrel bore.
2. Quick burning powder is used to ensure quick development of pressure.

8.7 Consumable Cartridge

The idea of a caseless cartridge is attractive. It saves a lot of expense in the manufacture of both the firearm and ammunition. The idea must have been hovering in the minds of all those persons who are concerned with firearms, especially those who are working in defence departments of various countries.

The Germans were perhaps the first nation to give the idea a practical shape. During World War II, they experimented with a cartridge in which the case was made of nitrocellulose. The case was consumed immediately while the bullet was passing through the barrel. However, excessive heat developed, heated the barrel after a few shots. It damaged the barrel. Besides, the heat developed 'cooked' the cartridge before it settled properly in the chamber after a few shots.

The difficulties have been overcome and the cartridge is a reality now. The caseless cartridge has been manufactured. Heckler and Koch has come up with a caseless cartridge and are manufacturing it for their unconventional 4.7 mm G11 rifle which can fire 2000 rounds per minute of the caseless ammunition.

The cartridge case is made of a special high explosive composition mixture termed H.I.T.P. (High Ignition Temperature Propellant). This propellant develops low temperature without affecting the power. It resists being initiated from the external heat prevailing in the firearm chambers due to repeated rapid fire. The new propellant has the following additional qualities:—

a. It gives greater power per unit volume.
b. It burns cleaner, leaving lesser residues than the conventional propellant.

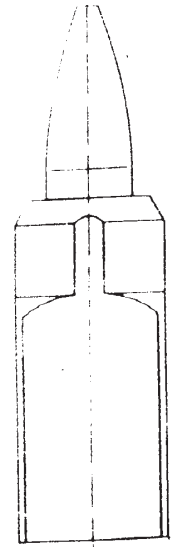


Fig. III-16

Heckler and Koch caseless cartridge.

Table III-22

Caseless Cartridge

Total length	34 mm
Length of the case	21 mm
Diameter of the case	9 mm
Diameter of the bullet	4.7 mm
Weight of the cartridge	5 g.
Weight of the bullet	3.4 g

The caseless cartridge will have significant impact on forensic ballistics, if it is used in crimes. Absence of cartridge case will hamper the identification of the firearm and affect other investigative aspects.

8.8 Duplex Cartridge

A duplex cartridge in .223 calibres has been introduced in USA. The cartridge has two bullets instead of one. They are fitted in tandem. They leave the muzzle one after the other. They hit the target at 300 metres within a circle of one metre diameter.

9. POLICE AMMUNITION

The police forces in India are using military ammunition in riots and terrorist cases. However, there is a need for different types of ammunition that should have the following characteristics:—

1. The projectile should have substantial stopping power. The person hit should be immobilised.
2. It should not ricochet and injure or kill innocent person(s).
3. It should not pass through the desperado hit and kill others.

A lot of work is being done to produce special police ammunition to ensure the above objectives. The best results obtained so far, are with a projectile made of copper alloy, with a hollow point, in which a plastic plug is fitted. The hollow point has a vent reaching the base of the bullet. The gases push the plastic plug away and the bullet becomes a hollow point bullet. Being made of low-density material, the projectile loses velocity quickly. The hollow point ensures deformation of the projectile after hitting the target and transferring the energy to the target, incapacitating the individual. At the same time the loss of velocity and deformation ensure no further or extensive damage by the projectile.

The projectiles being tried in police ammunition are:

9.1 Pellet Pouch Projectiles:

A plastic pouch containing pellet charge is used as projectiles. On hitting the target, the plastic pouch breaks up and releases the pellets, which hit the aimed person and de-capacitate him. The projectiles have controlled velocity and size to harm only the targetted person and not others who may be quite close to him. In a modification of the above, the pouch is replaced with a think copper jacket, open at the nose end.

Such ammunition is useful to incapacitate aircraft hijackers, as they do not penetrate aircraft body.

9.2 Fragile Bullets

Fragile bullets disintegrate on hitting the target. They do not ricochet nor do they cause through and through injuries. Hence, they do not injure any person other than the aimed person.

Fragile projectiles are made from metallic powders (iron, copper) and bound together with plastic adhesive into desired shape and size.

*APPENDIX**

There is general ignorance about arms and ammunition among the general public including those who have to deal with them as part of their duty in the dissemination of justice. The chapter preceding the appendix deals with various aspects of ammunition in general term. The appendix has been compiled to give specific information relating to the ammunition being manufactured in India. The information is certainly useful to all concerned with criminal justice system.

1. Cartridge SA 12 Bore 70 mm "ASTRAM"

1.1 General

This ammunition is fired from a 70 mm chamber 12 bore gun. This cartridge is an improvement on our existing popular brand "Special" Paper cartridges in so far as their construction and performance characteristics are concerned. The body is made up of high density polyethylene plastic tubes, bi-axially oriented, to withstand higher pressures and achieve higher velocity in place of paper crimson. The use of LDPE Power Piston with pouch in place of paper air-cushion as used in "Special" cartridges, not only provides better gas sealing but also results in achievement of higher accuracy in firing giving a very good pattern of shots. The cartridges use non-corrosive caps along with tubular anvils which eliminates occurrence of misfires. The use of smokeless propellant power give no smoke after firing and the use of hardened lead shots give a good impact on the target. The above improved characteristics make these cartridges suitable not only for use in general hunting, etc. but also for "competition shooting". Our "Astram" cartridges have already found great favour with many renowned shooters in the competition shooting games.

1.2 Physical Characteristics

Total length of finished ammunition after filling	58 mm
Total length of empty case	70 mm
Total mass of the ammunition	47 g
Composition of the primer	Al mixture
Charge mass of the composition	23 to 29 mg
Type of propellant	smokeless
Charge mass of the propellant	1.7 to 1.9 g
Mass of the projectile (lead shots)	32 g
Type of lead shots	Chilled
Hardness of lead shots	15 to 18 VPN
Range of shot size presently manufactured	From Biggest no. 1 To smallest No.9

Shot No.	Diameter	No. of shots per 32g
1	3.63 mm	113
9	2.02 mm	652

1.3 Performance Characteristics

1.3.1 Velocity at 9 m from muzzle: 350 ± 15.2 m/s

1.3.2 Accuracy: Accuracy of hit of pellets within 76.2 cm circle; target place at 27.4m distance from the muzzle.

---

* *Source*: Internet Indian Ordnance Factories.

a. With choked barrel 90%
b. Without choked barrel 56%

1.3.3 Pressure maximum permissible: 3.5 TSI/54.0 Mpa

1.4 Special Features

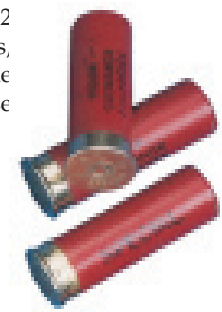
a. The Astram Cartridges use bi-axially oriented HDPE tubes which give highly superior quality of cases which protects the fillings inside the case form the vagaries of weather conditions.
b. The use of plastic power pistons with pouch for the expulsion of the shots from the barrel ensures higher accuracy of hit.
c. Higher velocity parameters and use of chilled lead shots ensure better hit on the target.

1.5 Shelf Life of 5 years, maximum.

2. Cartridge SA 12 Bore 65 mm "SPECIAL"

2.1 General

This ammunition is fired from a 70 mm/65 mm Chamber 12 Bore Gun. This is generally used for hunting, scaring away of animals, crop protection etc. Non-corrosive caps are used in the cartridges. The use of smokeless propellant power give no smoke after firing and use of quality lead shots gives a good impact on the target.



2.2 Physical Characteristics

Total length of finished ammunition after filling	60.5 mm
Total length of empty case	65.0 mm
Total mass of the ammunition	44.7 g
Composition of the primer	Al mixture
Charge mass of the composition	23 to 29 mg
Type of propellant	smokeless
Charge mass of the propellant	1.7 to 2.1 g
Mass of the projectile (lead shots)	30 g
Type of lead shots	Chilled
Hardness of lead shots	13 VPN
Range of shot size presently manufactured	From Biggest No. BB to smallest No. 9

Shot No.	Diameter	No. of shots per 30g
BB	4.08 mm	74
9	2.02 mm	616

2.3 Performance Characteristics

2.3.1. Velocity at 9 m from muzzle 320 ± 15.2m/s

2.3.2. Accuracy: pellets within 30" circle, at target at 27.4 m from muzzle

a. With choked barrel 90%
b. Without choked barrel 56%

2.33. Maximum permissible pressure 3.5 TSI/54 Mpa

2.4 Shelf Life

Shelf life of the cartridge in 5 years.

3. Cartridge SA 12BORE "MAGNA" & "DELUXE"

3.1 Physical Characteristics	*Magna*	*Deluxe*
Total length of finished ammunition after filling	64 mm	59 mm
Total length of empty case	70 mm	65 mm
Total mass of the ammunition	49 g	45 g
Composition of the primer	A1 mixture	A1 mixture
Charge mass of the composition	23 to 29 mg	23 to 29 mg
Type of propellant	smokeless	smokeless
Charge mass of the propellant	1.8 to 2.0 g	1.5 to 1.75 g
Mass of the projectile (lead shots)	34 g	30.1 g
Type of lead shots	Chilled	Chilled
Hardness of lead shots	13 VPN	13 VPN
Range of shot size presently manufactured	Biggest BB to smallest no. 9	Biggest BB to smallest no. 9

Shot No.	Diameter	No. of shots per 34g	No. of shots per 30.1g
1	3.63mm	120	106
9	2.02mm	695	616

3.2 Shelf life

The Shelf life of the cartridges is maximum five years.

4. Cartridge Rim Fire .22" BALL

4.1 General

The cartridges are of rimmed type. The complete cartridge consists of a cartridge case with rimfire composition, propellant charge and bullet. The rimfire makes thus a cartridge without a percussion cap. It is rimmed out to hold the initiatory composition. The striker of the rimfire rifle is placed eccentric to the axis of the barrel, so that when the rifle is fired, it pinches the rim and thus fires the cartridge. The bullet is made of lead antimony alloy and is unjacketed. The bullet is round nosed and formed with three circumferential grooves.

4.2 Physical Characteristics

Total length of Ammunition	25 mm (approx.)
Total mass	3.54g
Mass of bullet	2.60 g (approx.)
Mass of Initiatory composition	26 to 29 mg

4.3 Performance Characteristics

Velocity at 9 m	305 ± 23 m/s
Mean Figure of Merit at 23 m	95% within 19 mm circle dia.

4.4 0.22" Rim Fire Ammunition

Type of Ammunition	Velocity at 9 Metres	Accuracy	
		Mean figure of merit at 25 yds (23m)	Distance between two distant shots in a target of 5 rounds at 50 Metres

22 " RF Short	925 ± 50 ft./Sec (282 ± 15.2 m/Sec)	Min. 95% with in ¾" dia (19 mm) circle
.22 " RF Long	1000 ± 75 ft./Sec (305 ± 23 m/Sec)	Min. 95% with in ¾" dia (19 mm) circle
.22 " RF Tracer	1000 ± 75 ft./Sec (305 ± 23 m/Sec)	Min. 95% with in 1½" dia (38 mm) circle
.22 " RF for Precision Shooting	1050 ± 16.4 ft./Sec (320 ± 5 m/Sec)	

5. .32 Pistol/Revolver Cartridges

5.1 Characteristics

Type of Ammunition	Velocity at 30 ft.	Accuracy	
		at 30 Yds	at 40 Yds
.32" Long revolver	775 ± 24 ft./Sec (236 ± 7.6 m/Sec)	MFM 2.1" (5.33 cm)	MFM 2.8" (7.11 cm)
.32" short revolver	700 ± 25 ft./Sec (213 ± 7.6 m/Sec)	MFM 2.1" (5.33 cm)	MFM 2.8" (7.11 cm)
.32" Pistol	950 ± 50 ft./Sec (290 ± 15.2 m/Sec)	MFM 2.1" (5.33cm)	MFM 2.8" (7.11cm)

6. Cartridge SA 9 mm Ball

6.1 Role

These cartridges are of rimless type and are used with 9 mm pistol or 9 mm Machine Carbine Sten. This cartridge consists of cartridge case, percussion cap, propellant charge and a bullet. This case is of solid drawn brass. At the base of case, a cap chamber with an anvil and two fire holes are formed. A groove is provided on the case for easy extraction of the fired case. The cap is filled with VH2/E1 composition. The cap is secured in the cap chamber and annulus of cap is

lacquered to seal the cap and the cap chamber. The bullet is round nosed and consists of Lead-antimony core in an envelope of gilding metal. The cartridge case is tightly coned on to it.

6.2 Physical Characteristics

(i) Total length of Ammunition	H-29.69 mm L-28.91 mm
(ii) Total mass of Ammunition	11.94g ± 0.65 g
(iii) Maximum diameter	9.96 mm
(iv) Explosive filling in case	0.450 g (approx) propellant SPA-2 or propellant NC-688
(v) Cap Composition	23mg VH2 compo E1 compo

6.3 Performance Characteristics

(i) Mean velocity at 18 m. from muzzle	397 ± 15m/s
(ii) Accuracy	75.2 mm Mean Figure of Merit at 45 m
(iii) Pressure	Mean 201 Mpa Individual 215 Mpa No single round should exceed 216 Mpa.

6.4 Special Features

This ammunition can be used with Pistol and Machine carbine. Its main role is defence rather than attack.

6.5 Shelf Life

Shelf life is 7 years.

7. Cartridge SA .380″ BALL Revolver

7.1 General

These cartridges are of rimmed type and fired through .380″ Revolver. This round consists of a cartridge case, percussion cap, propellant charge and bullet. The case is of solid drawn brass. At the base of the case, is a cap chamber, with an anvil and two fire holes. The percussion cap is of brass and contains Czech type (non-fulminate base) mixture. The cap is secured in the cap chamber and the annulus of the cap is lacquered with purple varnish which ensures water proofing and identification of ball cartg. The bullet consists of lead antimony core in a cupronickel or gilding metal envelope and has a slight concave depression in the base to prevent the lead core from extruding and making the base faulty.

7.2 Physical Characteristics

Total length of Ammunition	31.62 mm
Total mass of Ammunition	16 g (approx.)
Mass of bullet	11.54 ± .13 g
Mass of propellant	0.260 g

7.3 Performance Characteristics

Mean velocity at 9 m	183 ± 9 m/sec
Accuracy from fixed rest	90 mm mean F of M at 46 m

7.4 Shelf Life

The shelf life of the Ammunition is 15 years.

8. .315/8 mm & .30-06 Cartridges

8.1 Characteristics

Cartridge	Velocity	Accuracy
0.315/8 mm	2000 ± 50 ft/sec (610 ± 15.2 m/Sec) at 90 ft. (27.4 m)	3.5″ (9 cm) Max at 200 Yards (183 m)
.30″- 06	850 ± 10 m/sec at 27.4 m	8 cm Max at 185 m

9. INSAS 5.56 mm Ball AMMN

9.1 General

Cartridge (INSAS) 5.56mm Ball Ammn is used in antipersonnel role by infantry and is fired from;

(a) Semi-automatic INSAS Rifle

(b) INSAS LMG

9.2 Physical Characteristics

(a) **CARTRIDGE**

Calibre	5.56 x 45 mm
Mass	12.85 gm
Length	60.00 mm

(b) CASE

Type	Rimless, Brass 70:30, Bottle Necked, Boxer
Mass	6.7 gm
Length	45.0 mm

(c) BULLET

Type	Guilding Metal envelope FMJ, Steel insert & lead core
Mass	4.16 gm
Length	24.5 mm

(d) PROPELLANT

Type	Ball Powder
Mass	1.64 gm

(e) PRIMER

Type	Boxer
Mass of Compo	0.025 gm

9.3 Performance Characteristics

(a)	Pressure Average	335 Mpa (Max)
(b)	Mean Velocity from 558 mm barrel at 25 m from muzzle	890 m/s.
(c)	Consistency (Mean Figure of Merit at 457 m)	16.5 cm or less
(d)	Extreme temperature performance	-52 to +72 deg C

9.4 Shelf Life

The shelf life of the cartridge is 18 years.

10. 5.56 mm BALL Mk N AMMN (SS 109)

10.1 General

The Cartridge 5.56 mm Ball Mk N is equivalent to 5.56 mm NATO (SS 109) ammunition and are suitable for 5.56 mm standard weapon for firing, which can use 5.56 mm NATO Ammunition or INSAS Ammunition.

10.2 Physical Characteristics

(a)	**CARTRIDGE**	
	Calibre	5.56 x 45 mm
	Length	57.4 - 57.6 mm
(b)	**CASE**	
	Type	Rimless, Brass 70:30, Bottle Necked, Boxer
	Length	45.0 mm
(c)	**BULLET**	
	Type	Guilding Metal envelope FMJ, Steel Insert and Lead core
	Mass	4.0 gm
(d)	**PROPELLANT**	Ball Powder Double Base (NG & NC)
(e)	**PRIMER**	Lead Styphnate base, Boxer type

10.3 Performance Characteristics

(a)	Pressure (Radial)	342 Mpa (Avg) 356 Mpa (Max)
(b)	Velocity at 25 m from standard test barrel	910 ± 10 m/s.
(c)	Consistency Mean Figure of Merit at 457 m from standard test barrel	16.5 cm or less
(d)	Penetration at 700 mtrs	90% of rounds shall penetrate 3.45 mm NATO standard MS Plate to hardness 95-123 VPN
(e)	Action time (Hang Fire)	0.003 second max
(f)	Extreme temperature range	-54 to +52 deg C

10.4 Shelf Life

The shelf life of the cartridge is 15 years.

11. 5.56 mm Ball Mk M NATO AMMN

11.1 General

The Cartridge 5.56 mm Ball Mk M is equivalent to 5.56 mm NATO (M193) ammunition and are suitable for 5.56 mm standard weapon for firing, which can use 5.56 mm NATO Ammunition or INSAS Ammunition.

11.2 Physical Characteristics

(a) **CARTRIDGE**

Calibre	5.56 x 45 mm
Length	57.4 - 57.6 mm

(b) **CASE**

Type	Rimless, Brass 70:30, Bottle Necked, Boxer
Length	45.0 mm

(c) **BULLET**

Type	Guilding Metal envelope FMJ and Lead core
Mass	3.56 gm

(d) **PROPELLANT** Ball Powder Double Base (NG & NC)

(e) **PRIMER** Lead Styphnate base, Boxer type

11.3 Performance Characteristics

Parameters	
Bullet Weight	3.56 gm
Bullet Type	Ball
Muzzle velocity at 78feet (24 meters)	964 m/s.
Muzzle energy at 78feet (24 meters)	1656 Joules
Pressure:	
Maximum average	3660 kg/cm^2
Maximum average + 3sd	4080 kg/cm^2
Accuracy (R)	2.5cm at 100m, 5.0cm at 180m

11.4 Shelf Life

The shelf life of the cartridge is 12 years.

SYNOPSIS

1. GENERAL

2. ENERGY CONSIDERATIONS

2.1 Propellants

2.2 Initiation

2.3 Combustion of Propellants

2.4 Density of Loading

2.5 Atmospheric Temperature

2.6 Shape of the Cartridge Case

3. HEAT PROBLEMS

4. PRESSURE

4.1 Determination of Pressure

1. Crusher Technique
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3. Special Projectile Method

5. RECOIL

5.1 Measurement of Recoil

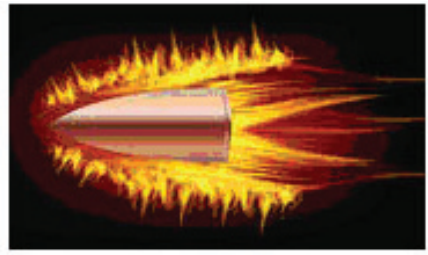
5.2 Miscellaneous Facts about Recoil

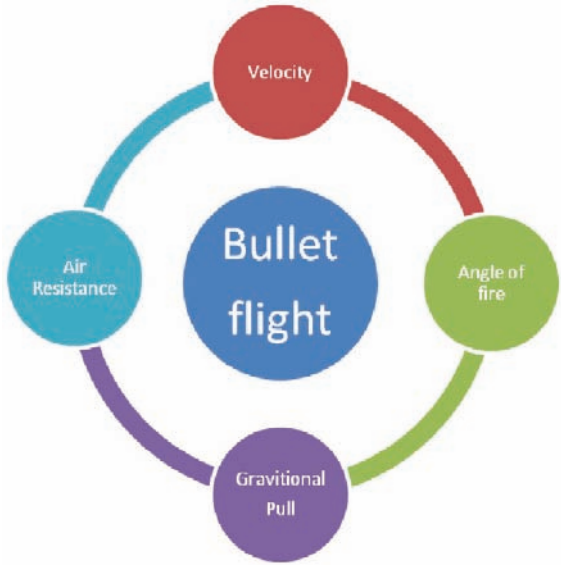
6. VIBRATION AND JUMP

7. BARREL FOULING

4

ELEMENTARY FORENSIC BALLISTICS





Ballistics Determiners

1. GENERAL

Ballistics is the science that mainly deals with the launching of projectiles, their flight, behaviour, and their effects, especially of bullets, bombs, and the like. The main factors, which affect the ballistic of a projectile, are:

1. The Velocity of the projectile with which it is hurled in the air.
2. The angle at which it is fired (the launch angle).
3. The gravitational pull.
4. The resistance of the medium through which it moves.

It requires mathematical proficiency to study the theoretical aspects of the subject, its practical applications in ballistic missiles, and in the launching of the satellites or for inter-space transport. However, small arm ballistics does not require the higher mathematics to understand the basic principles of the Forensic Ballistics. It is however, needed for research work. In fact, rigid mathematical treatment for small arm ballistics is not attempted in Forensic Ballistics. Most of the formulas and derivations are empirical, based upon the observed experimental results. Therefore, the awe, which the word ballistics excites in the minds of the non-specialist readers, concerned with Forensic Ballistics, is rather ill founded. A person who knows elementary mathematics can follow the treatment of small arm ballistics, discussed in most of the books on small firearms. The following is a still simpler elementary version.

2. ENERGY CONSIDERATIONS

A projectile needs energy to set it into motion. The simplest way to do so is manual; for example, a stone is thrown manually or with the help of a sling. Similarly, an arrow, in motion, is also a projectile. In both cases, the energy is limited as it is the human energy, which is used. In small arms, chemical energy is harnessed for propelling the projectiles.

2.1 Propellants

Black powder, also called gunpowder, was the first propellant used in firearms. It was a mechanical mixture of the following ingredients:

Table IV-1

Potassium nitrate (KNO_3)	= 75%
Sulphur (S)	= 10%
Charcoal (C)	= 15%

Substances like nitrocellulose and nitroglycerine has replaced the black powder, more or less, completely. The propellants from these compounds are more effective. They decompose rapidly, producing large volumes of gases at high temperatures. As the decomposition takes place in a confined space, the gases produce high pressure. The pressure is channelled to act upon the projectiles and put them into motion.

The propellants are self-sufficient in all the ingredients for their chemical transformation to gases. The proportions of the ingredients is so adjusted that most of the materials are converted from the solids to the gases. The chemical change for nitroglycerine is:—

Nitroglycerine

↓

Carbon dioxide + Water vapours + Oxides of Nitrogen + Oxygen + Nitrogen

It has been found that one gram of nitroglycerine produces one thousand cm^3 (cubic centimeters) of gases, measured at normal temperature (0^oC) and pressure (760 mm.). The heat given by the reaction is also tremendous – about one thousand calories. The temperature often crosses 3000^oC.

Table IV-2

ENERGY, TEMPERATURE AND GAS VOLUMES
FROM ONE GRAM OF COMMON PROPELLANTS *(AT NTP)*

Powder	*Gas volume (ml.)*	*Temperature °C*	*Heat (cal.)*
Gunpowder	280	2230	705
Cordite	880	3100	1150
MD Cordite	930	2700	975
Gun cotton	875	2500	980

Only a portion of this energy is converted into kinetic energy of the projectile. Most of it is wasted.

The distribution of energy in a .303 Mark VII cartridge containing about 2.4 grams of MD cordite is given below—

Table IV-2A

ENERGY DISTRIBUTION IN .303 CARTRIDGES ON FIRING

Energy	*Cal.*	*Ft. lb.*
1. Total energy[1]	= 2400	7404
2. Kinetic energy received by the projectiles[2]	= 725	2237
3. Energy wasted as heat[3]	= 700	2160
4. Energy used in overcoming barrel friction[4]	= 175	540
5. Energy wasted in recoil, heating, etc.	= 100	308
6. Energy accounted for as above	= 1700	5245
7. The balance energy	= 700	2160

Most of the balance energy is dissipated as muzzle blast.

The amount of energy produced and utilized in the motion of the projectile varies somewhat under different conditions.

The distribution of energy of one round (bullet weight 150 grains and muzzle velocity, 2800 ft/sec.) of a Browning Machine Rifle has been given in Hatcher's Notebook as under:—

Table IV-2B

1. Total energy	= 3076 cal.
2. Kinetic energy of the bullet	= 885 cal.
3. Kinetic energy of the gases	= 569 cal.
4. Heat energy	= 1625 cal.

1. Total energy is calculated from the rise in temperature when a weighed amount of powder in a closed vessel, immersed in water, is exploded.
2. The muzzle energy of the projectile is calculated from:—$E = \frac{1}{2} mv^2 = \frac{1}{2} \times 174/(7000 \times 32) \times (2440)^2$ = 2237 ft. lbs. =725 Cal. [for .303 rifle projectile]
3. To estimate heat energy, the barrel is surrounded by a water jacket. The number of shots fired to raise the temperature to boiling point, is noted. The amount of heat produced is calculated and dividing it by the number of shots, heat per shot is found.
4. Friction energy is calculated from the temperature rise of the projectile. This energy is half of the total as a similar amount must be expended on the barrel.

2.2 Initiation

When the trigger is pressed, the firing pin strikes the primer and compresses the primer mixture, which explodes and produces flame and heat rays. They ignite the powder charge to produce gases which push the projectile(s).

If the amount of the primer mixture in the pellet is less (inadequate), old or defective, the initiation of the powder charge is slow and irregular. The conversion of powder charge to gases consequently is also irregular. The projectile does not acquire the energy it should have otherwise acquired.

Again, if the the primer mixture quantity in the pellet is large, the powder charge is burnt more quickly. Thus, the pressure developed by the cartridge may be sudden and excessive. It may endangers the shooter and the projectile may not acquire intended muzzle energy. A sluggish movement of the firing pin spring may also similarly affect the projectile ballistics.

2.3 Combustion of Propellants

There are wide variations in the rate of burning of the powders. Some powders burn quickly, other burn slowly. Various firearms require different burning rates. For example, in pistols and revolvers, a very quick burning powder is needed so that the powder is converted into gases before the projectile is pushed out of the short barrel of the firearm if the projectile is to acquire the desired velocity.

Likewise, quick burning powder is not suitable for long barrelled firearms. The projectiles need sustained pressure, for which a powder with appropriate burning rate is used.

The rate of burning is adjusted to the length of the barrel.

The strength of the barrel and action of the firearm to withstand the pressure determines the upper limi of pressure in a firearm.

2.4 Density of Loading

Density (S) of loading is given by the formula:—

$$S = v/V \times 100$$

[Here v = volume occupied by the powder, and

V = volume of the cartridge case.]

In rifle cartridges, the loading density is 75 to 95. Higher loading densities are useful. They permit uniform burning, proper development of pressure, regular velocities and they are economical. Low density of loading often gives 'hang fire', incomplete combustion and irregular velocities. Improper loading density materially affects the range and the aim of a shot.

2.5 Atmospheric Temperature

The ammunition is manufactured to give the desired velocities and pressures at a particular atmospheric temperature. If the temperature differs only slightly at the place of the use, the ballistic aspects are not seriously affected. If temperature variations are substantial (*e.g.* in Ladakh or in Rajasthan desert), they affect the ballistic aspects of the ammunition. In hot places, the pressures developed may be excessive and the firearm may burst. In cold places, the ammunition may

develop low velocities. Indian Ordnance Factories manufacture most of their ammunition with a temperature tolerance of — 52°C to 72°C.

It has been found that the variation in velocities because of the temperature is about one metre per second per degree centigrade.

2.6 Shape of the Cartridge Case

It has been observed that if there is an abrupt junction of the neck and the case, the rounds develop greater pressure (for the same quantity of powder). The combustion is more uniform. It appears that abrupt neck joint deflects the hot gases inward. The hot gases promote quick ignite the powder charge in every nook and corner. Thus, correct initiation and complete combustion of the powder charge takes place inside the cartridge case. It reduces excessive heating and wear and tear of the barrel.

3. HEAT PROBLEMS

In the combustion of propellants, the temperature may reach 3000°C. The barrels of the firearm melt at these temperatures, if the gases at the temperature remain in the barrel for any appreciable time. However, fortunately the time for which the hot gases are in contact with the barrel is about 0.001 second. Therefore, the high temperature does not create the havoc, which is expected, otherwise. Instead, there is gradual erosion, called 'washing', of the barrel due to continued flow of the hot gases. They carry away metal slowly but surely. The 'washing' effect though slow, ultimately increases the barrel diameter. Both the aim and the range are affected considerably by the increase in the diameter.

The erosion is comparatively rapid in automatic or semi-automatic firearms. Here the barrels do not get sufficient time between the shots to cool in between the shots. The erosion at higher temperatures is greater. Nitroglycerine powders, which generate higher temperatures, causes the barrel erode to more quickly.

The leed, the barrel portion joining the chamber with the barrel bore, is the first part of the firearm to be affected. A widened leed facilitates the escape of the gases and consequently affects the ballistics (aim and range) of the projectile.

Gas cutting is another phenomenon observed in the excessively used firearms. The out-rushing hot gases, at certain points, either due to some deformity in the projectiles or erosion of the leed, come out in the form of jets which create furrows. The furrows go on widening and deepening with passage of time due to the ever-increasing volumes of gases rushing through these channels.

The excessive heat and high temperatures sometimes deform the projectile especially lead projectiles, affecting its ballistics.

4. PRESSURE

Formation of excessive pressures may burst the firearm, causing even fatal accidents, at times. Such cases come up in criminal investigation. Likewise, some firearms-ammunition pair may develop low pressures, which change the ballistics of the projectiles and create injuries which require careful evaluation.

A firearm-ammunition pair develops pressure, which mainly depends upon:—

(1) The quantity and quality of the powder charge.
(2) The space available for expansion.
(3) The speed of initiation and burning.
(4) The chemical nature of the powder.
(5) The shape/size of the propellant.
(6) Progressive powders develop considerably less maximum pressure for the velocites.
(7) The shape and the size of the projectiles affect.

Service rifles develop high pressures. For example, the pressure developed by Mark VII round in a .303 rifle is of the order of 3400 Kg per cm^2. A 12-bore shotgun develops a pressure of the order of 500 Kg. per cm^2.

High pressures are a necessary evil, because greater the pressure, greater will be the velocity of the projectile being pushed by the expanding gases. This is literally true with non-progressive and quick burning powders.

High pressure has some undesirable effects:—

(1) Increased wear and tear of the firearm barrel.
(2) Increased recoil.
(3) Increased temperatures.[1]
(4) A rough idea of the pressure (in tons) can be had from the formula:—

$$\mathbf{P = KW^{2.25}}$$

[Here, W = wt. of the powder in grains,
K = constant dependent upon arm-ammunition system]

The formula is useful to know the effect of the variations of the amount of powder in a given firearm and the cartridge.

The pressure developed by a given amount of powder is measured. The value of K is determined which is used for finding out the pressures for the other amounts of powder.

More detailed and accurate formulations for determining these values are available in the advanced works on the subject.

4.1 Determination of Pressure

The pressure developed by the ammunition is always measured to find out if the same is within the safe limits or not. Ordinarily, the measurement is done in the factory itself.

There are two methods generally used to determine the pressures:—

1. Crusher Technique

In the crusher technique, a solid cylinder of standard dimensions and purity made of either lead is used for cartridges (pistol/revolver cartridges) developing low pressure. Copper cylinder is used for cartridges developing high pressure

1. PV = RT. Alternatively, P α T (where V is constant in a firearm).

(service rifle ammunition!). The pressure developed in a cartridge is allowed to crush the cylinder. The decrease in the length, due to crushing, is measured. Comparison with standard reductions indicates the pressure developed.

There are two arrangements. In one, the backward thrust of the fired cartridge is utilized to crush the cylinder. The cartridge case is properly oiled to reduce friction in the backward journey. In the second arrangement, a small hole is drilled in the chamber of the firearm used to carry out the test. This hole is in line with another hole in the cartridge case.

The pressure developed in the cartridge case is transmitted through this hole to a piston that in turn crushes the cylinder. The decrease in the length of the cylinder, as before indicates the pressure.

The lead cylinders are used in the firearms developing low pressures and copper cylinders are used in those firearms, which develop high pressures.

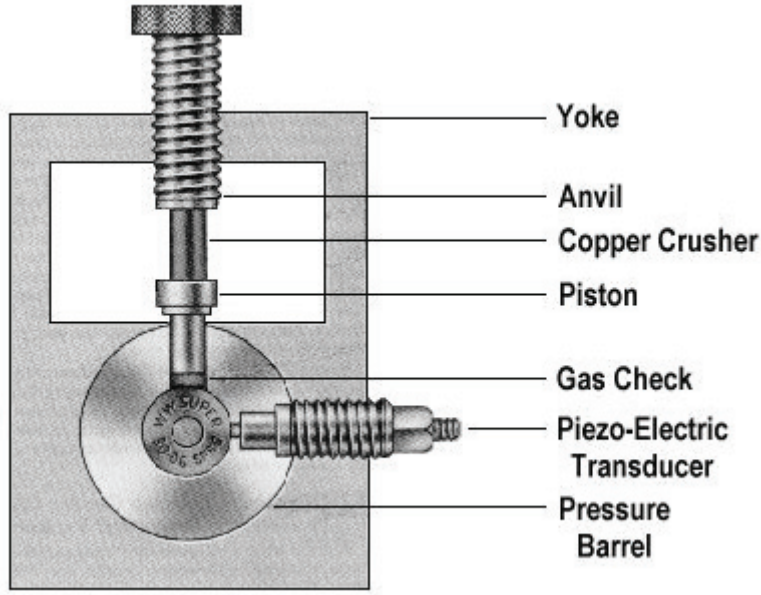


Fig. IV-1

Schematic arrangement for measuring pressures through crusher/Piezo-electric crystal

2. Quartz Crystal Technique

In quartz crystal technique, a number of crystals are arranged in an orderly fashion. The pressure developed in a gun is allowed to play upon the train of the crystal through a hole in the chamber. An electromotive force is developed across the crystals. It is proportional to the pressure developed. Measurement of the electromotive force indirectly measures the pressure developed.

3. Special Projectile Method

Special projectiles have been developed which have devices fitted at their bases. These devices measure the pressure at the base of the projectile and its acceleration.

5. RECOIL

If the firearm is not handled properly or the arm or ammunition is defective, the firing may cause injury (injuries) to the shooter. The injuries identify the shooters. The improvised 12 bore pistols often recoil to cause injures which link the culprit with the crime. Such injuries may identify a death as homicidal/ suicidal/accidental death.

In an interesting case of gang war, the leader of one gang was killed. The eyewitnesses, members of his gang alleged that they were attacked while they were running away from the killer gang. They had no firearms and did not give any fight. However, recoil injuries on the person of the deceased on the left hand, proved that he had fired a firearm with his left hand: the deceased carried evidence that he had given a gun-fight:

1. *There was blackening and tattooing on hypothenar and thenar region. The presence of blackening and tattooing indicated, beyond reasonable doubt, that he had fired a firearm with his left hand, which caused the blackening and tattooing at the sites that is apparently from the smoke that comes from the chamber end.*
2. *There were injuries, on his left hand, on the hypothenar region, distal phalange of the little finger and on thenar eminence. They were lacerated wounds only. They could not caused by projectile(s). The presence of GSR further fortify the thesis that these injuries were caused because the victim held the firearm loosely*

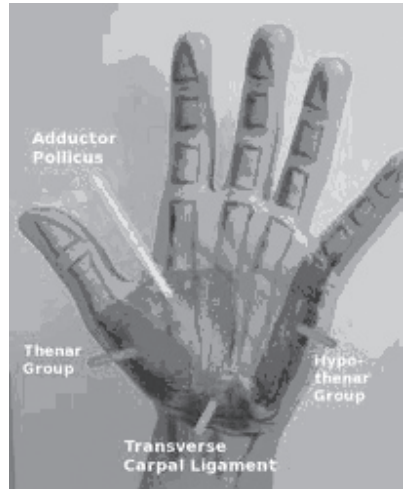


Fig. IV-2

The lacerated region coloured (schematic)

3. *The position of the handgun held in the left hand is illustrated in the figures below. The arrowheads indicate the sites of contact on the left hand and they will be the sites of injuries, due to recoil, when a firearm is held loosely. The deceased must have fired the firearm holding the same loosely. Recoil of the firearm lacerated the sites to cause the injuries.*

Fig. IV-3

The holding of the firearm to cause the given recoil injuries:
a. Exterior view of hand and the affected parts b. Medial view of the hand

4. *They were not caused by projectiles because:*
   - *Injuries were close to each other. No shooter, under the circumstance of the case, could achieve so close a group of injuries, even if he wanted to.*
   - *There were no punctured/tear wound(s) which were were inevitable if they were caused by projectiles.*
   - *Injury sites corresponded to the contact sites when a handgun was held and fired.*
   - *The force of recoil is equal and opposite to the force with which the projectiles(s) goes forward (**To every action there is equal and opposite reaction**). This force moved the firearm violently and injures the hand.*
   - *The severity of injuries depends upon the recoil force and the looseness with which the firearm is held.*

In short, injuries on the left hand of the deceased were recoil the handgun was held loosely at the time of firing. (CH)

Recoil is the backward movement of the firearm. It gives an unpleasant kick and sometimes injures the shooter, if the firearm is not held properly or the recoil velocity is excessive.

Recoil is governed by Newton's third law of motion. The momentum with which the ejecta moves forward, is the same with which the firearm moves backward. This momentum is responsible for the recoil. The recoil velocity of the firearm is very low as compared to the velocity of the projectile leaving the firearm; because the firearm is held firmly in the hand or with the shoulder. The body forms a part of the recoil system to reduce the velocity of the recoil. If, however, a shoulder firearm is held loosely in a contact or near contact position, the recoil can bruise the shoulder. Likewise, in handguns the hand is bruised.

Three factors contribute towards the recoil:

1. First, the **forward motion of the ejecta** (projectiles, wads, powder residue particles), they contribute about 50 % of the recoil force.
2. Second, **the out-rushing gases** contribute about 10 % of the recoil force.

3. Third, **the muzzle blast** contributes about 40% of recoil force. Blast pushes the firearm backward in the same way as the blast propels a jet aeroplane or a rocket.

The recoil velocity due to the various factors can be calculated.

i. Recoil velocity in a gun (with mass M) due to projectile with mass m_1 and velocity v_i:—

$$\mathbf{MV = m_1v_1}$$

$$\mathbf{V = m_1v_1/M}$$

[Here, V = recoil velocity, M = mass of the gun,

m_1 = mass of the projectile, $v_{1\ =}$ velocity of the projectile]

ii. Recoil velocity (Vg) due to gases:—

$$\mathbf{Vg = m_2v_2/M}$$

[Here, v_2 = the average velocity of the gases
m_2 = mass of the powder charge].

iii. It is difficult to know the exact value of the recoil velocity due to the blast. It is often calculated from the total recoil velocity after subtracting the recoil velocities due to projectiles and gases.

Thus:

Total recoil velocity	= 5 m/s.
Velocity due to projectiles	= 2.5 m/s.
Velocity due to gases	= 0.5 m/s.
Remaining velocity due to blast	= 2 m/s.

It is not difficult to visualize the blast effect on the recoil. When the projectile leaves the muzzle of the firearm, the gases inside the barrel become free to expand. The exit of the projectile leaves a sort of vacuum. The expanding gases (also being lighter) rush out and acquire the velocity in excess to the velocity of the projectile. The out-rushing gases constitute the muzzle blast.

It has been observed that the velocity of the blast gases is obtained from the average velocity of the projectile multiplied by the factor, K. The value of K varies from 1 to 2 depending upon the velocity of the projectile. For high intensity projectiles, the value, 2, is appropriate; for high velocity service rifle projectiles, the value of K is about 1.75 and for shotgun projectiles, the value 1.25 appears to be more appropriate.

Keeping all these factors in view a combined formula for the recoil velocity 'V_R' is:—

$$\mathbf{V_R = (m_1 + km_2)\ V/M}$$

Here: k is the blast factor and its value varies from 1 to 2. M, m_1 and m_2 are masses of gun, projectiles and powder respectively. V is the muzzle velocity of the projectiles/gases.

5.1 Measurement of Recoil

The recoil measurement is important; mainly in the manufacture of firearms/ and ammunition. There are a number of techniques to measure it. Outlines of the common methods are given below:—

(1) The firearm is fixed to a ballistic pendulum and fired. The movement of the pendulum is measured. The recoil velocity is ascertained from the momentum.

(2) The firearm is suspended from some fine wires and the backward movement velocity (recoil velocity) of the gun is noted with a high-speed camera.

(3) The dynamometer measures the compression of a spring or the depth of indentation in lead. Comparison with the known compressions or indentations gives the recoil velocity.

(4) A standard gun (about 25 kg) is suspended from the wires about two metres long. The arc of the gun makes after firing is noted and used for calculating the recoil. This data can be used to determine the recoil in the other guns.

5.2 Miscellaneous Facts about Recoil

(1) The recoil has been used in automatic and semi-automatic firearms to work the loading and firing mechanisms. The recoil-operated firearms give somewhat greater kick.

(2) The recoil is carefully controlled in the small arms especially in rifles and shotguns. The recoil velocity is not allowed to exceed 5 m/s. Excessive velocities give 'gun sickness' after a few shots.

(3) The recoil makes the muzzle of pistols and revolvers jump. This is compensated while fixing the sights.

(4) The recoil is reduced or eliminated through Cutt Compensators. Manipulation of muzzle brake devices reduces the recoil to the desired extent.

(5) The recoil is eliminated in the recoilless guns. The cartridge case of recoilless round is perforated with numerous small holes. The chamber of the gun is made much larger than the cartridge. The chamber and the breech have a large number of holes with controlled directional outlets. The out coming gas jets thereby take definite directions so that the rotation of the gun due to the rotation of the projectile inside the barrel is compensated. The number of the holes is so adjusted that the gun is propelled forward by the jets only to that extent which neutralizes the backward travel due to recoil. Thus, the gun does not show recoil.

(6) Tolerable recoil velocity[1] is up to 15 f/s. High velocities cause '**Gun Headache**'.

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1. *Textbook of Small Arms*. Her Majesty Office (HMO) London, 1929.

6. VIBRATION AND JUMP

The release and the striking of the hammer cause some vibrations in the firearm. However, these vibrations are 'drowned' by those caused by the movement of the projectiles in the barrel.

As soon as the projectile starts forward motion, the firearm starts moving backward and upward. The upward movement of the barrel is called the jump. The jump is noticeable in handguns. The vibrations and the jump are considerably affected by the manner in which the firearm is held.

Backward motion is responsible for the recoil and recoil injuries.

A double-barrelled shotgun also suffers side way vibrations.

The jump and vibrations are important only rarely in forensic ballistics.

7. BARREL FOULING

Barrel fouling is due to powder residues, primer residues or metal particles scraped from projectiles. In defective firearms/ammunition, incomplete combustion may also leave unburnt powder particles though it is rare. The deposits adversely affect the ballistics of the projectiles fired through the fouled barrel.

When a black powder cartridge was used, extensive barrel fouling from the powder residue was formed. The repeated firing could turn the fouling into a 'cake', by compressing the successive layers of the fouling that ultimately obstructed the smooth movement of the projectile(s) in the barrel. It was difficult to remove the barrel fouling when 'caking' had taken place.

The smokeless powder also fouls the barrel, but the magnitude is far less. However, if the barrel is not cleaned periodically, it affects the accuracy.

The metallic fouling is a serious problem where lead bullets are used. However, the use of jacketted bullets, even in the revolvers, largely reduce the fouling. Electroplating, of bullets was once used as a remedy but it was found to be more troublesome.

Metallic brushes remove metallic fouling.

INTERNAL BALLISTICS

SYNOPSIS

1. GENERAL

2. FIREARMS

2.1 Barrel

2.2 The length of the barrel

2.3 The bore Characteristics

2.4 The muzzle of the barrel

2.5 Energy Transfer

2.6 Rifling

2.7 Chamber

2.8 Recoil

2.9 Barrel Rifling Twist

2.10 Chamber Cone

3. AMMUNITION

3.1 Propellants

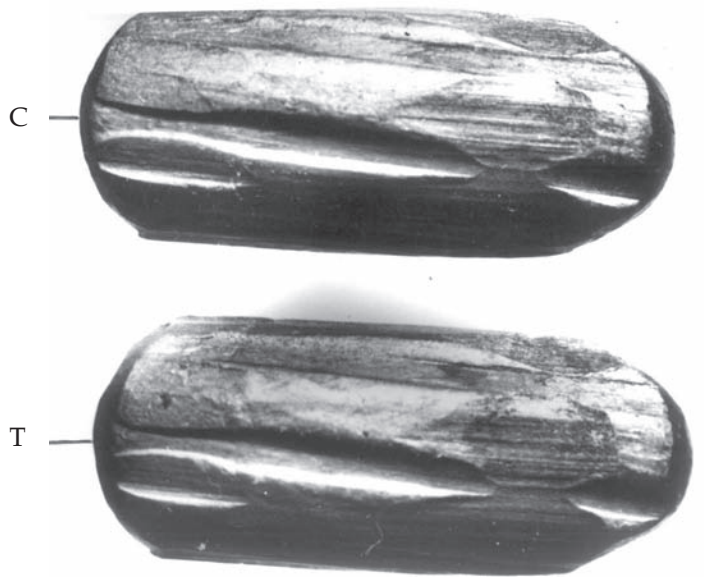
3.2 Primer

4. FIRING PROCESS

4.1 Time distribution

5

INTERNAL BALLISTICS



Undersized barrel bore elongated the bullets and created peculiar but corresponding marks.

1. GENERAL

Internal or Interior Ballistics is the study of happenings, their causes, and their effects that take place in the barrel of a gun from the time the primer is struck and the propellant ignites to the time when the projectile exits the gun. It is mainly the study of the firing process and the movements of the projectile and the ejecta (products of combustion formed in the burning of the powder, etc.) in the barrel from the chamber end to the muzzle end.

The Internal Ballistics discussed in this chapter relates only to small arms and their ammunition, which are usually involved in crimes. It studies:

(1) **The marks scratched on the projectiles passing through the barrel**. They links the projectile with the firearm used. Loose barrel do not scratch identifiable marks on the projectile. In under-sized bore of the barrel, the projectile may not exit and block the barrel. Alternatively, it may not leave identifiable marks.

(2) **The velocity of the projectile**. A projectile will acquire proper Ballistics only if it is manufactured to matches the barrel/firearm. An oversized barrel give loose fit to the projectile, which does not seal the bore of the barrel and allows gases to escape It reduces the pressure of the gases on the projectile and hence its velocity/energy. The reduction, in turn, reduces its wounding power. It also does not pick up barrel marks systematically.

(3) **Defects in the barrel** (obstruction, excessive fouling). They may cause firing accidents. They affect the line of fire, the trajectory of the projectile.

(4) **The cause of the erratic behaviour of the projectiles**. In some cases, the firing process and the projectile show abnormal behaviour.

The internal ballistics involves many entities and processes, including:

(1) The firearm,

(2) The ammunition, and

(3) The firing process.

They and their interactions, *inter se,* give birth to Internal Ballistics. They are discussed in the following pages.

2. FIREARMS

Firearm is the entity, where the initiation and burning of propellants, confining of the gases to generate high pressure to push the projectile through the barrel and imparting it velocity, spin, stability, etc. take place. The firearm is the device that ensures the objectives to achieve proper aim, range and striking power for the projectile. The firearm has to be strong to withstand the high pressure/temperature for its repeated use. The barrels of the firearm, therefore, are made strong to withstand the use/misuse.

2.1 Barrel

The main functions of the barrel of a firearm are to:

(1) Provide space for various processes involved in the firing of a cartridge.

(2) Provide helical lands and grooves to impart spin to the moving projectile.

(3) Provides uniform bore so that the intended projectile seal the barrel throughout from the breech end to the muzzle end. The sealing helps the bullet to acquire desired velocity and spin.

(4) Provide chamber to house the cartridge.

(5) Provide chamber cone for smooth passage of the projectile from cartridge to the rifled barrel.

(6) Provide specially machined muzzle end, so that the projectile:

a. Exits at the muzzle end in nose-onward position and releases the residual pressure symmetrically.

b. Keeps and maintain the projectile in the intended trajectory. A sideward push will deflect the bullet from its path.

c. Ensures orderly exit maintain the intended path.

2.2 The length of the barrel

The length of the barrel is such that the propellant is completely consumed by the time the projectile exits the muzzle. If the barrel is long, the propellant is consumed before the projectile reaches the muzzle end. The gas gets space to expand. Some energy is lost in the expansion. It reduces the propulsion force on the projectile and hence the velocity of the projectile is reduced. In shorter barrel, the propellant remains unconsumed. The intended pressure/velocity/ kinetic energy is not achieved. The barrel length in service rifles is usually 50 to 65 cm.

The following table gives an idea of the effect of extra barrel length on the reduction of the velocity.

Table V-1

S. No.	Velocity Range: Feet/s	Velocity Reduction (Feet)
1	0 → 2000	5-10
2	2000 → 2500	10-20
3	2500 → 3000	20-30
4	3000 → 3500	20-40

2.3 The bore characteristics

The bore of the barrel should correspond to the diameter of the projectile, which should seal the bore. If the bore diameter is less than the diameter of the projectile, it can cause serious accidents. If the calibre is larger, the projectile will not seal the bore and gases will escape from the sides, decreasing the velocity/ energy of the projectile and deflect the projectile from its intended trajectory.

The projectile must seal the bore of the barrel properly, to utilize full power of the gases. It is achieved through:

a. The bore is made uniform throughout the barrel; or, has regulated minimal taper towards the muzzle.

b. The diameter of the projectile is made to correspond to the uniform bore. If the bore diameter is larger than the diameter, the projectile shifts sideways. In addition, the gases leak from the sides of the projectile, not only decreasing its velocity and power, but may also tip the bullet and thus affecting its nose-on flight after its exit and affect its aim and range.

Lapping gives uniform barrel bore. It removes any constriction affecting the diameter of the bore of the barrel. It ensures smooth and uniform bore. Fire-lapping technique is the in-thing currently. Especially loaded, low-power cartridges carrying abrasive-covered soft-lead bullets are fired through the barrel that lap the barrel.

2.4 The muzzle of the barrel

The muzzle of the barrel is the endpoint of the contact of the projectile and the gun barrel in Internal Ballistics. It controls the release of the projectile and the ejecta created in the firing. It is the endpoint of the journey of the projectile in the barrel. The muzzle end can seriously affect the trajectory of the projectile if it is asymmetric. The asymmetry will cause uneven pressure on the base of the projectile, which will change the trajectory of the projectile from the intended path. The muzzle end is therefore, beveled or recessed to protect it from protrusions or scratches, which affect accuracy. A good muzzle end is symmetrical. It gives a uniform star-shaped pattern of the GSR muzzle print taken after firing. If the GSR print is irregular the muzzle end need reshaping.

2.5 Energy Transfer

A projectile acquires energy from the gases produced from the burning of the propellant. The propellant cannot be increased beyond a certain limit because excessive pressure can cause barrel burst. Therefore, better utilisation of the gas pressure/energy is adopted. There are two ways:

(a) Increase the diameter of the projectile so the there is greater push to the projectile due to the greater area for the gases to act upon. However, it has its limitations. Larger the diameter of the projectile, greater is the drag on the projectile after it exits the barrel. Besides, the projectile, in the flight, loses velocity quicker. The range is therefore, adversely affected.

It is against this background that military handguns have usually 9 mm bore diameter and the military rifles have mostly 5.56 mm to 8 mm diameter bore.

(b) The projectile is given a sustain push for a longer distance/time. It acquires more velocity/energy. This sustained push is achieved through slow/progressive propellants and having longer barrel. Thus, in military rifles, this mode is used to generate higher velocities/ energies.

Here also the barrel length has to be limited. It is usually kept around 50 cm. The Indian INSAS rifle has a barrel of 464 mm.

2.6 Rifling

The lands and grooves of a barrel create resistance to the movement of the projectile. Their dimensions (depth, width and twist) are created after research and experiments. If they do not correspond to the researched dimensions, they do not give proper ballistics.

2.7 Chamber

The size of the chamber has to correspond to the size of the cartridge. If the diameter is less the case after firing may be stuck in the chamber. Large size can cause burst of the cartridge case/firearm. Obturation is adjusted carefully.

2.8 Recoil[1]

According to Newton's III law, there is always equal and opposite reaction to an action. The firing of a firearm propels the projectile/ejecta forward with certain force. The process pushes back the firearm with equal momentum/force. The backward movement of the firearm is called recoil. Greater the recoil greater is the gun-sickness to the shooter. It is therefore, controlled:

(1) The amount and burning characteristics of the propellant are so adjusted that the forward energy is not excessive.

(2) The weight of the firearm is adjusted to limit the backward velocity of the firearm. The firearm, firing high velocity ammunition, is rested against the shoulder. The process reduces the backward push to negligible limits.

(3) The muzzle brake or recoil compensator devices redirects the exiting gases in the barrel push the muzzle down and forward. The forward push compensates the recoil of the gun. The downward movement counteracts the rotation and upward jump of the firearm. It prevents recoil effect on the shooter and keeps the aim on line.

These devices are also used in handguns for accurate firing.

Muzzle brake requires longer, heavier barrel. They increase sound and flash. Sound can damage the hearing of the shooter, often permanently.

2.9 Barrel Rifling Twist

The helical rifling in a barrel gives spin to the passing projectile. It ensures proper grip of the projectile, prevents tumbling and keeps it in nose-onward position. Further, it does not allow air to form an air wall in its flight after its exit from the barrel. The barrel wall reduces the velocity/energy of the projectile and deletes it from the intended trajectory.

There are three types of rifling twist in the barrels:

(1) **Uniform Twist** from breech end to muzzle end. The projectiles set in the grooves/barrel and seal the bore absorbing the full force of the push of the gases.

(2) **Decreasing Twist** changes angle of the rifling of the grooves. Grooves become narrow leaving gap for the gases to leak. T adversely affects the ballistics of projectile in many ways.

(3) **Increasing twist** from breech end to muzzle end maintains the barrel sealing.

The increase/decrease in twist angle is only minimal.

The velocity of the projectiles determines the angle of rifling twist, usually. For high velocity rifles, it is about one turn 23 cm to 30 cm. It can be estimated, roughly, from the following formula:

$$\textbf{Twist} = (K \times D^2)/L$$

[T = Twist (barrel length in inches to complete one turn)

1. Discussed in some details in chapter 4 on 'Elementary Ballistics'.

K = Specific gravity constant

D = Bullet diameter in inches

L = Bullet length in inches]

2.10 Chamber Cone

Chamber Cone is the space between the projectile nose (head) in the chamber and the start of the rifling. It is also called throat, leed (lead) or free bore. It helps the projectile to set properly in the grooves of the barrel quickly and correctly. The projectile reaches the rifled area and sets in the grooves. In low power firearm there is hardly any freebore. In high power rifle there is considerable chamber cone/throat. It inhibits development of excessive pressure in the chamber. Longer cone, however, can cause misalignment, which leads to tumbling of the projectile. Therefore, the freebore is adjusted carefully keeping the above factors in view to ensure proper development of pressure and setting of the projectile in the grooves.

3. AMMUNITION[1]

Ammunition used in small arms is usually fixed type, complete rounds, and ready for firing. It has the following components:

(1) Propellant.

(2) Primer.

(3) Projectile.

(4) Cartridge case.

Ammunition is the main determiner of the internal ballistics. Its numerous aspects concerned with internal Ballistics may be summarized:

(1) The propellant: its nature, shape, size, quantity, burning rate (progressive, degressive, neutral), loading density, uniformity of burning.

(2) The primer.

(3) The cartridge case: its construction, capacity, space for expansion of gases, constriction to develop initial pressure to push the projectile.

(4) The projectile: its weight, diameter *vis-à-vis* the barrel (whether it seals the bore or not), its fitment in the cartridge case, the pressure/velocity it needs to leave the cartridge case.

(5) The barrel bore space for expansion, smooth bore for the projectile travel, uniformity of muzzle end for proper exit of the projectiles/other ejecta, chamber cone (freebore), etc.

3.1 Propellants

A propellant is the main determiner of Internal Ballistics. On ignition, it burns with speed and creates gases in the confined space of the barrel, which spin the projectile in a rifled firearm, push the projectile through the barrel to the muzzle. It is hurled out with velocity/energy and spin in the direction the firearm is aimed. The propellant is responsible for the interaction/interplay of the firearm, its barrel and other parts, projectile, gases and other ejecta.

1. For details see the chapter 3 on Ammunition.

The first propellant used in firearm was black powder (also called gunpowder), a finely ground, pressed and granulated mechanical mixture of sulfur, charcoal, and potassium nitrate or sodium nitrate. It gave many ballistics problems including:

(1) It fouled the barrel extensively. If the same were not cleaned frequently, the fouling would affect the ballistics of the small arms.

(2) It could not give high (required) velocities in service rifle with reasonable quantity of the powder.

The black powder is no longer used in most of the ammunition of small arms.

The next important propellant was nitrocellulose. Ballistically it has the following main advantages:

(1) It produce very little smoke and thus the barrel of a firearm is not fouled too much.

(2) It gives high velocities with reasonable amount of the propellant.

(3) It could be changed/moulded into various ballistically useful forms (cylinders, tubes, balls, grains or flakes of various sizes) to suit different firearms.

(4) The rate of burning is controlled by manipulating the structure of the propellant grains, by additives or by coating the propellant suitably.

Nitroglycerin, though a powerful explosive was not quite suitable for small arm ammunition. It was too dangerous to use it alone as a propellant. It was modified by mixing it with nitrocellulose (usually to the extent of 3 to 39 %) to give double-base propellants like cordite and ballistite, etc. Even in double base propellants, it has some disadvantages:

(1) Create high temperature.

(2) 'Wash' the barrel aggressively.

Nitroglycerin as a propellant ingredient has been in use since long. The propellant is manufactured in various forms (rods, tubes, slotted-tube, perforated-cylinder or in multi-tubular shape) to create needed burning properties like those of progressive/depressive propellants.

3.2 Primer

Primer is a small cup of copper (or other metal/alloy) containing a pressure sensitive explosive material, called priming mixture, which is sandwiched between the base and an anvil. The primer is fitted in the base of the cartridge. It initiates the firing process. When the firing pin of a firearm strikes the primer in the centre, the mixture 'explodes' on compression and gives out heat and flame. They set the propellant burning, generating a large volume of gases (*vis-à-vis* the volume of the propellant), high pressure and temperature. The gases push the projectile forward with increasing velocity until they leave the barrel muzzle.

Defective primers due to improper manufacture or deterioration do not set the propellant on fire correctly and thus change the ballistics of the ammunition/projectiles.

In caseless cartridge ammunition, there are no primers. Ignition is achieved either electrically or through chamber gas pressure.

4. FIRING PROCESS

4.1 Time distribution

Hatcher breaks the duration of interior ballistics into three parts:

(1) Lock time, the time from sear release until the primer is struck.

(2) Ignition time, the time from when the primer is struck until the projectile starts to move.

(3) Barrel time is the time the projectile takes for its journey in the barrel.

The time taken in these processes, have significance for accuracy. If the firearm is moving, then a shorter lock time minimizes the effect of that motion. The consistency of the ignition and barrel times affect the muzzle velocity.

There are many significant processes involved in the firing:

(1) The burning of propellant, the source of energy, generates hot gases that raise the pressure in the cartridge.

(2) The pressure pushes the projectile out of the cartridge, and causes the projectile to move with increasing acceleration in the barrel. The pressure depends on many factors like the amount of propellant that has burned the temperature of the gases, and the space in the cartridge/ chamber.

(3) The burning rate of the propellant depends not only on its chemical composition, but also on the shape of the propellant grains.

(4) The temperature depends upon the energy released and the heat lost to the sides of the barrel and chamber, to the cartridge case and the bullet. The volume of the burning space is continuously changing: as the propellant burns, barrel bore provides the additional space for the gas to expand. As the projectile travels down the barrel, the gas volume behind the projectile also increases.

There are other effects also. Some energy is lost in deforming the projectile and causing it to spin. There are also frictional losses between the projectile and the barrel. The projectile, as it travels down the barrel, compresses the air in front of it.

Hatcher breaks the duration of interior ballistics into three parts:

(1) Lock time, the time from sear release until the primer is struck.

(2) Ignition time, the time from when the primer is struck until the projectile starts to move.

(3) Barrel time, the time the projectile takes from starting to move until it exits the barrel.

These time intervals have significance for accuracy. If the weapon is moving, then a shorter lock time minimizes the effect of that motion. The consistencies of the ignition and barrel times affect the muzzle velocity.

Many processes are significant. The source of energy is the burning propellant. It generates hot gases that raise the pressure. That pressure pushes the projectile, and causes the projectile to accelerate. The pressure depends on many factors like the amount of burnt propellant, the temperature of the gases and the volume of the chamber. The burn rate of the propellant depends on its chemical composition, the shape of the propellant grains and the pressure developed.

The temperature inside the barrel depends on the energy released, the heat lost to the sides of the barrel and chamber, the speed of burning and the nature of the propellant.

The volume of the expansion space changes continuously. As the projectile travels down the barrel, there is more volume for the gas to occupy.

As already mentioned there are some energy losses in deforming the projectile, causing it to spin, frictional losses between the projectile and the barrel and in compressing/pushing the air in its front.

EXTERNAL BALLISTICS

SYNOPSIS

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2. TRAJECTORY: THE PROJECTILE PATH

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2.2 Drop
2.3 Angle of Fall
2.4 Remaining Velocity
2.5 Maximum Range
2.6 Vertex Height
2.7 Experimental Trajectory Determination
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2.10 Drift
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2.12 Structure of the Projectile
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2.15 Influence of Earth
2.16 Air Resistance
2.17 Retardation
2.18 Velocity
2.19 Density and Temperature
2.20 Measurement
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3. RICOCHET

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4.5 Patterns
4.6 Stringing
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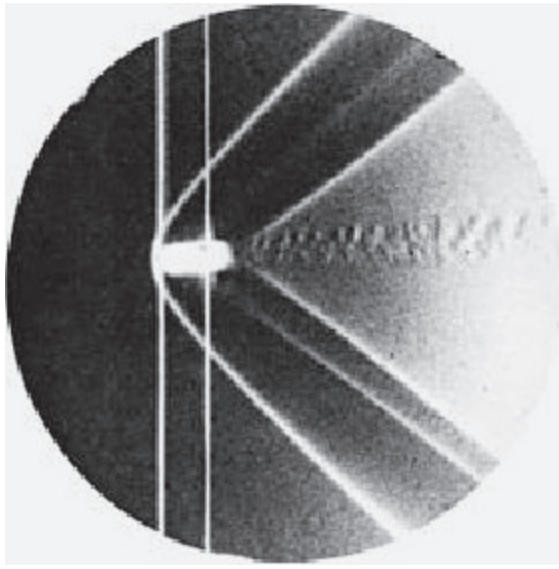
4.8 Extreme Range

5. ESCAPE VELOCITY

6

EXTERNAL BALLISTICS



Photo/Shadowgraph of the shockwaves around a bullet in supersonic flight

1. GENERAL

The motion of projectile in the open atmosphere forms the subject matter of External/Exterior Ballistics. The path traversed by the projectile is trajectory. It is parabolic in shape. The trajectories of all projectiles are parabolic. They differ mainly in their heights, lengths and curvatures and other flight characteristics. The factors, which influence the trajectory formation, are many, including:

1. The velocity of the projectile.
2. The presence/absence of spin of the projectile and its rate of spin
3. The angle of fire.
4. The constructional features (shape/Sectional density/ballistic coefficient) of the projectile.
5. The barrel characteristics of the firearm, especially the uniformity of the bore/muzzle end.
6. The atmospheric conditions at the time of fire.
7. The prevailing temperature of the site.

The study of the exterior ballistics, in forensics, facilitates:

1. The determination of extreme and effective ranges.
2. The reconstruction of shooting incidences whether the given incident is case of accident, suicide, murder or killing in self defence.
3. The appraisal of ricochet and its possibilities to cause deaths/injuries incidents.
4. The verification of the version(s).
5. The determination of the sequence of events.
6. The fixing of danger/safe zones at the firing range.
7. The appraisal of ricocheted bullet injuries.

2. TRAJECTORY: THE PROJECTILE PATH

When a projectile is fired, it should go along the axis of the barrel of the firearm and travel equal distances in equal intervals of time, if no external force or forces act upon it to change its velocity and direction[1]. However, two important forces act upon the projectile, which change its trajectory. The forces are:

1. Air resistance, and
2. Gravitational pull of the earth.

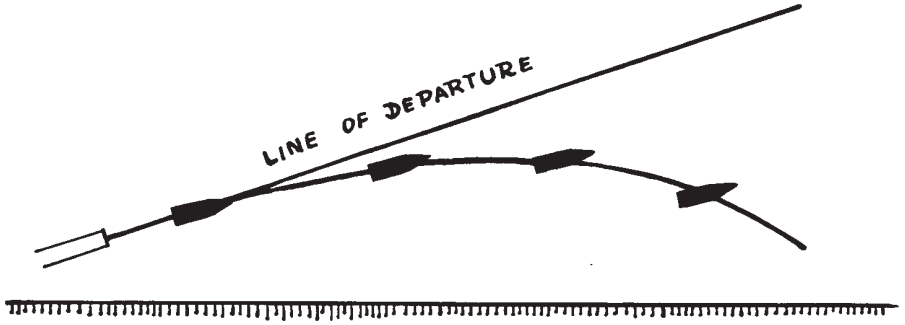


Fig. VI-1

Formation of Trajectory

The position of the stable bullet axis is usually parallel to the line of fire.

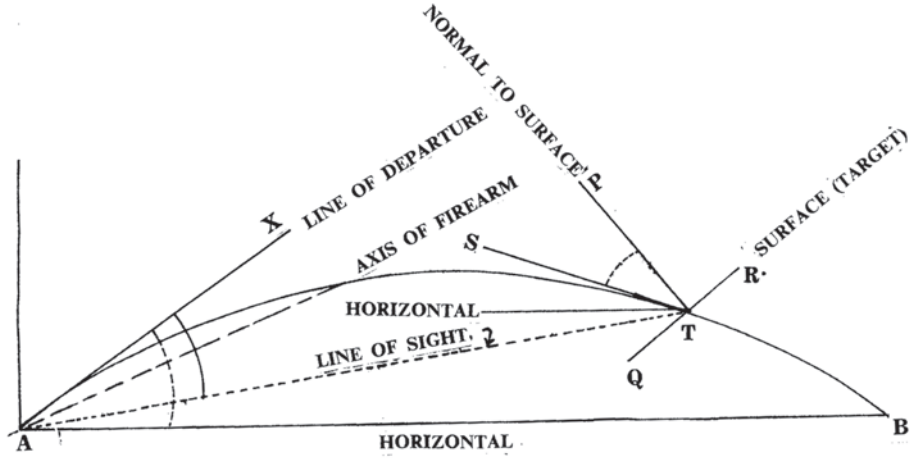
The forces affect the trajectory and determine its characteristics, which mainly constitute exterior ballistics. Theoretical determination of the trajectory of a projectile needs the knowledge of higher mathematics and complex formulae. The influencing factors vary so much at different intervals of times, during the flight of a projectile that even the best theoretical derivations may be rough approximations only. They are, therefore, of not of much practical use in forensic ballistics. They, therefore, do not form part of this discourse.

The trajectories in vacuum are simpler. They give the basic idea of trajectory formation and facilitate understanding of the exterior ballistics.

1. Newton's first law of motion.

The air resistance, as mentioned above, is one of the main determiners of trajectory formation. In vacuum, air resistance does not affect the trajectories. The formulations and derivations for vacuum trajectories are, though not fully applicable for real trajectories are close approximations, especially with low velocity projectiles. They are adequate to understand Forensic Ballistics.

The vacuum trajectories have however, assumed importance in another dimension *i.e.*, in space travel and the exploration of other world beyond our planet. Space vehicles move where actual vacuum conditions prevail.



∠ XAB = Angle of Elevation ∠ STP = Angle of Incidence

∠ XAT = Angle of Projection ∠ STQ = Angle of Fall

Fig. VI-2

Various terms used in trajectories

There are many determiners of a trajectory are. The important ones have discussed below:

1. The initial velocity or muzzle velocity (V) of the projectile.
2. Projectile mass, shape, sectional density.
3. The range, the distance travelled by a projectile, designated by 'R'.
4. The angle of elevations (E) is the angle, which the axis of the barrel makes with the horizontal. This is used to find other elements of the trajectory.
5. The vertex, its highest point in the trajectory.
6. The drop (the projectile vertical fall), the distance through which the projectile falls from the line or fire at a given range or time interval, represented by 'D'.
7. The striking angle, which the tangent to the curve makes with the horizontal at the striking point, designated be 'F'.
8. Air resistance.

9. The remaining velocity, 'Vr' at a particular range or after an interval of time 't'.
10. Ballistic coefficient of the projectile.
11. The effect of temperature of the propellant.
12. Spin and spin drift.
13. Primer characteristics, its mal-functioning.
14. Arm-ammunition match.
15. W influence on speed/directions/defection/drift.
16. Projectile's vacuum drag.
17. Lateral drift due non-uniform muzzle.
18. Vertical lift/jump.
19. Aiming/sight adjustment errors due to wrong estimation of the range/ distance of the target.
20. Manufacturing deficiencies in the firearm.
21. Lacunae in the manufacture of the ammunition.
22. Shooter's failure.

2.1 Range

The determination of the range for a vacuum trajectory is based upon the fact that the horizontal component of the velocity of the projectile does not change, and the force of gravity is constant. Consequently, the distance travelled by the projectile in time 't' is given by:—

R = t x effective velocity (horizontal component of the initial velocity)

= t x V Cos E.....1

[R = Distance travelled by the projectile

E = Angle of elevation, V = initial (muzzle) velocity and

t = Time of flight of the projectile.]

2.2 Drop

Drop of a projectile is its vertical fall at a given range (distance) or time during its flight. The drop is continuous as the gravitational pull of the earth is continuous. It is given by the equation:—

D = 1/2 gt2 2

[*D = Drop*

G = Gravitational pull factor

T = time for which the projectile has been travelling]

The drop in high velocity projectiles is negligible for short ranges (up to 100 metres), as the travel time small.

The estimation of the drop is helps to find the height of the trajectory at any point of time. We know that the velocity, which is taking the projectile upward, is V sin E. If the projectile has taken **'t'** second and there is no gravitational pull, the projectile will reach the height (H_v) is given by:

$$H_v = t\ V \sin E$$

However, the gravitational force is continuously pulling the projectile downward to the extent of 1/2gt2. The height (Ha) of the projectile after the time interval t, in the air, therefore, is:

$$H_a = t \acute{}\ V \text{ Sin } E — ½\ gt2 \quad \text{..... (3)}$$

The fall due to gravitational pull is adjusted in fixing the sight of the firearm. If the fall is 3 cm at the range of hundred metres the aim is elevated by one minute $\frac{1}{(60)^0}$.

2.3 Angle of Fall

The angle of the fall can be calculated from the formula:—

$$\text{Tan } F = \text{Tan } E - g\ t\ /V \text{ Cos } E \quad \text{..... (4)}$$

Thus, Tan F can be known after any interval 't' if we know V and E. Angle F can be found from the tangent tables.

2.4 Remaining Velocity

The value of remaining velocity (Vr) is found out from the formula:—

$$Vr = \sqrt{V^2 - 2\ g\ t\ x\ V \text{ Sin } E + g^2t^2} \quad \text{.....(5)}$$

2.5 Maximum Range

Maximum range is determined from the equation '3' above, used to find out the height (H) of the trajectory.

$$H = t\ V \text{ Sin } E – ½\ gt2$$

At the maximum range**, H = 0, Therefore:** Putting this value in the range formula:—

$$0 = t\ V \text{ Sin } E – ½\ gt2$$

$$\text{Or, } t\ V \text{ Sin } E = ½\ gt2$$

$$t = 2\ V \text{ Sin } E$$

Putting this value in Range equation, R = t x V Cos E (equation '1' above), we have:

$$R = 2\ V \text{ Sin } E\ x\ V \text{ Cos } E/g$$

$$= V2\ x\ 2 \text{ Sin } E\ x \text{ Cos } E/g$$

$$= V2\ x \text{ Sin } 2E/g \quad \text{.....(6)}$$

$$= V2/g, \text{ when Sin } 2E \text{ has the maximum value of 1.}$$

Sine has a maximum value of 1 when the angle is 90°, *i.e.*, Sin 2E = l

$$2E = 90°, \text{ therefore } E = 45°$$

In vacuum trajectory, therefore, the maximum range is obtained when the angle of elevation is 45°. In air, however, the maximum range is obtained at lesser angles, 29° to 39°, depending upon the projectile and its velocity. .303 Mark VII ammunition and rifle gives maximum range at an elevation of 34° 42 minutes.

At vertex, the angle of the fall (F) is zero. Consequently, if this value is put in equation (4), (Tan F = Tan E-gt/V Cos E), we have:—

$$0 = \text{Tan } E - gt/V \text{ Cos } E; \text{ or,}$$

$$\textbf{Tan E = gt/V Cos E, Or,}$$

$$\textbf{t = V Sin E/g}$$

Now putting this value of 't' in range formula (equation '1' above), we have.

R(=R vertex) =V Sin E x V Cos E/g =V2 Sin 2 E/2 g ….....7

2.6 Vertex Height

The height of vertex can also be determined from the height of the trajectory formula:—

$$\textbf{H = t V Sin E– l/2 gt2}$$

Putting the value of 't' from above, we have:—

$$\textbf{H = V Sin E/g x V Sin E -– V2 Sin2 E/2 g}$$

$$\textbf{= V2 Sin2 E/g –- V2 Sin2 E/2g}$$

$$\textbf{= V2 Sin2 E/2 g .....8}$$

Table VI-1

VERTEX HEIGHT OF RIFLES

S. No.	Calibre	Projectile weight (Gr.)	Velocity(f/s)	Vertex height (f)
1	.303	175	2785	9420
2	7.62 mm	150	2756	7874
3	5.56 mm	50	3200	2650

2.7 Experimental Trajectory Determination

For the determination of the trajectory experimentally, an un-inhabited piece of land of appropriate dimensions is chosen. It should cover the range of the projectile under test, adequately. A thick and wide wall of earthwork to adequate height is raised behind the terminal (last) screen, to stop escape of projectiles from the range, to prevent accidents by stray projectiles.

The target screens are made of white bond paper, placed in proper frames. The heights and the positions of the screen from the base line are so adjusted that the centres of all the screens are in one straight horizontal line.

The bull's eye is painted on the terminal screen. It is visible somewhat through the bond paper or through holes created in the frontal screens. Alternatively, the intermediate screens are placed after the firearm has been aimed at the terminal screen, at the fixed points.

The test firing for the trajectory determination is done from a machine rest or from a bench rest. The heights of the holes from the base line at various screens give the height of the trajectory at the distances of the screens. Plotting the distances and heights on a graph paper gives the trajectory of the projectile. The final graph is made after a number of fires.

2.8 Shape of Trajectory

Both internal and external factors affect the shape of the trajectory. The internal factors are the velocity and the spin of the projectile, the angle of the

fire and the structural features of the projectile (and of the firearm). The external factors are the air resistance, the wind deflection, the gravitational pull and the rotation of the earth.

The most important factor, which determines the shape of the trajectory, is the velocity of the projectile. The greater the velocity, the flatter is the trajectory, other factors remaining the same.

In black powder days, it was not possible to achieve very high velocities in small arm ammunition because the recoil or the weight of the firearm or both increased inconveniently. With smokeless propellants, high velocities and hence flat trajectories have been achieved in small arm ammunition.

The flat trajectories are valuable because:—

(1) Wind deflection is reduced.

(2) Both aim and range improve. Errors due to estimation of the distances and angle of elevation are reduced.

(3) There are lesser vibrations of the firearm. It is due to the reduction in the time for which the ejecta remains in the barrel.

(4) The individual variations[1] of the cartridges become insignificant at high velocities, which are required for the flatter trajectories as the variations in the velocities will be only small as compared to the velocities generated by the use of smokeless powders.

(5) Idiosyncrasies of the shooter have reduced effect.

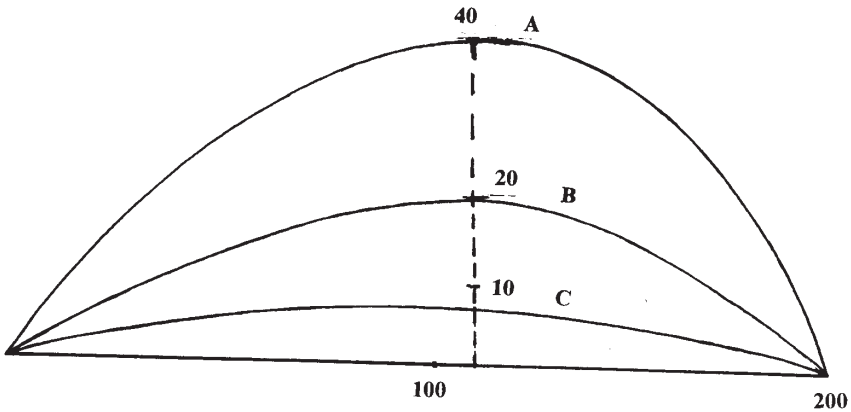


Fig. VI-3

Dramatic Effect of Velocity on the Shape of the trajectories (range 200 metres).
(A) the trajectory of the projectile with velocity 400 m/s.,
(B) the trajectory of the projectile with velocity 520 m/s.,
(C) the trajectory of the projectile with velocity 950 m/s.
(Trajectory heights in centimetres)

1. Changes in temperature, leakage of the gases, slight differences in weights of the projectiles and different rates of burning cause these variations.

2.9 Spin

The spin of the bullet is its revolving (gyration) around its longitudinal axis. Helical rifling gives the spin. A non-spinning projectile accumulates an increasing mass of air in its front, which retards the velocity and changes its trajectory. It disperses the air and thus prevents the accumulation of increasing mass of air in the front. It improves the ballistics of the projectile: improves both the range and the aim and helps to reduce air resistance.

The speed of the spin varies with the twist[1] (*i.e.*, the degree of turning) of rifling in the barrel. The twist (turning) required depends upon the diameter, the length and the density of the projectile. The density of the medium through which the projectile moves is also taken into consideration. The following formula gives the twist (length in which one turn is completed):—

$$\text{Twist} = \frac{150 \times \text{calibre}2}{\text{Length of the projectile}L2} \times \frac{\sqrt{10.9}}{D1} \times \frac{D2}{D3}$$

[D1, D2 and D3 are the densities of the projectile, medium of travel and air respectively.]

If the density of the projectile (D1) is less; then, the twist length has to be increased. Similarly, if the density of medium changes from air to water, the twist has to be increase considerably; about 30 times approximately.

The length of the barrel in which the rifling twist completes one turn is also called pitch.

For the small arm projectile, with a specific gravity of 10.9, Professor Greenhill has given a very simple formula:—

Twist length x bullet length in calibre = 150

Lengths of bullet and the twist are measured in calibre of the projectile.

In .303 rifles, where the length of the projectile is 5 calibres (1.5″/.303 = 5), we have the required twist length:—

Twist x 5 = 150
Or, Twist = 150/5 = 30 calibres
= 30 x .303″
= 9.09″
= 9″

Thus, in the .303 rifle barrel, the device to create groove is turned at a speed that it completes one turn in about 9 inches of barrel length.

The value (150) of the product of twist and the bullet lengths has been arrived at by the mathematical calculations of a hypothetical situation. It has been observed that the figure '150' is not sacrosanct. It can be raised up to 200 without any detrimental effect on the efficiency of the projectile-arm system, when the velocity of the bullet is above 200 f/s.

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1. It is the barrel length in which rifling completes one turn.

The rate of spin is tremendous. For example, .303-rifle and Mark VII projectile combination spins the bullet at a rate of about 3000 revolutions per second to start with. The loss of revolutions is about 5 to 10 per cent per second. Consequently, the spin is considerable at all practical ranges.

2.10 Drift

Whereas the spinning has undoubtedly improved both the range and the aim of the firearm, it has also introduced the drift. The drift is a sideway shift of the projectile from the line of departure. It takes the direction of the spin. If the spin is towards the right the projectile drifts towards the right. If the spin is towards the left, the shift is towards the left. In some rifles, however, there may be a side way jump of the barrel, which may compensate or even over-shoot the drift.

The following variables affect the magnitude of spindrift:

a. **Spin rate**: faster spin produce more spindrift because the nose ends up pointing farther to the side.
b. **Projectile length**: longer projectiles drift more because there produce greater lateral "lift".
c. **Range:** longer range increases spindrift with time of flight and trajectory height: all of these variables.
d. **Air density**: the denser the atmosphere, greater is the spindrift.

When a spinning projectile comes out of the firearm, it puts the air immediately in contact into spinning motion. This whirling air has a tendency to push the nose of the projectile laterally in the direction of its rotation.

The amount of drift is small especially in rifles and is not of much importance in forensic ballistic problems.

Table VI-2

DRIFT AT VARIOUS RANGES FOR .303 MARK VII AMMUNITION

Range (in metres)	*Drift (in centimetres)*
100	3
500	15
1000	30

At extreme ranges, drift is considerable and does not obey the simple relation indicated by the table. A calculated tilt of the sight helps to remove effectively the effect of the drift up to a range of about two thousand metres.

2.11 Angle of Fire

The angle of fire is the angle, which axis of the barrel makes with the base line. It is measured in minutes[1]. If the angle of fire (elevation) is one minute, then the line of fire and the base line will be apart by over one millimetre at four

1. In U.S.A. the angle of fire is measured in mils. One mil equals 3.375 minutes. The angle, one mil, subtends an area of one metre at one thousand metres. Roughly the value of the tangent of one mil is 0.001 (=1/1000).

metres, about thirty millimetres at hundred metres and about thirty centimetres at one thousand metres.

Table VI-3

EFFECT OF ELEVATION ON TRAJECTORY[1]

Elevation in degrees	*Range in metres*	*Vertex height in metres*	*Remaining velocity in m/s*	*Time of flight in seconds*
1	1040	0.15	306	2.24
5	2250	79	179	7.56
10	3000	218	136	12.65
20	3750	593	118	20.95
30	4040	1039	123	27.91
35	4075	1274	127	31.06
40	4030	1513	130	34.01

The angles of elevation in actual firing are commonly low. For hunting purpose they are even less, unless the target is at an angle.

Table VI-4

PRACTICAL RANGES AND VERTEX HEIGHTS[2]

Range (in metres)	100	200	300	400	500	600	700	800	900	1000
Elevation (in minutes)	3	8	12	17	22	29	38	47	59	72
Vertex height (in cm)	5	15	30	55	90	153	251	375	498	600

Note:—(1) The table is approximate only.

(2) The summit (vertex) is beyond the midpoint of the range, towards the target.

Some aspects of the angular firing, like the safe zone, the ricochet and the firing up and down the hill, offer some interesting points.

When firing at an angle, the elevation may give rise to what is called a 'safe zone' along the trajectory where the projectile will be travelling over the heads of the persons standing along/below the base line. The above table indicates that, if a .303 rifle is fired when the sights are set to a range of less than three hundred metres there is practically no safe zone throughout the range. At the greater ranges, however, there will be safe zones.

The safe zone can be determined with the help of a graph. The heights of the trajectory at various distances for the given elevation are plotted against the distance. Safe zone, for the given elevation, would be where its height is over and above the height of the human target (say, 2.5 m). Graph can indicate the safety zone limits easily.

1. Muzzle Velocity =800 m/s; Coefficient of the projectile =0.284.
2. For .303 mark VII ammunition.

2.12 Structure of the Projectile

The structural aspects of the projectile have a profound effect upon the trajectory because certain shapes and structures overcome air resistance better than the others and thus give better ballistics.

The ballistics of a projectile suffers set back to its movement in three ways:

a. **Skin friction**. It is due to the interaction of air and the metal molecules. It is negligible.

b. **Base drag.** The base drag to the projectile is due to vacuum by its forward movement The vacuum sucks the projectile backward. Boat tailing of the projectile has reduced it considerably. The base drag is more in high velocity projectiles

c. **Frontal or head resistance**. The head resistance is the most important retarding force acting on a moving projectile. It is directly proportional to the head area (called the projection area) which comes against the air. The lesser the area, the lesser is the air resistance and hence, better trajectory (and ballistics). The spitzer[1] bullets have thus become common and popular because of their high efficiency at long ranges.

The efficiency of the shape of a projectile to overcome the air resistance is measured in terms of 'coefficient of reduction'; it is also called the 'form factor'. For the projectile having a flat base and spitzer nose (standard shape), the coefficient of reduction (denoted by 'n') is 1. It varies with the shapes of the nose and the base of the bullet.

Fig. VI-4

INSAS Boat-tailed Spitzer Bullet

The coefficient of reduction is determined in the following ways:—

1. Experimentally by comparing the retardation of the projectile, under investigation with standard projectile.
2. By comparing the shape of the projectile with the standard shape.
3. By calculation, using the formula:—

1. Modern spitzer projectiles have pointed tip and boat-tailed base. Highly efficient projectile, especially for long range firing.

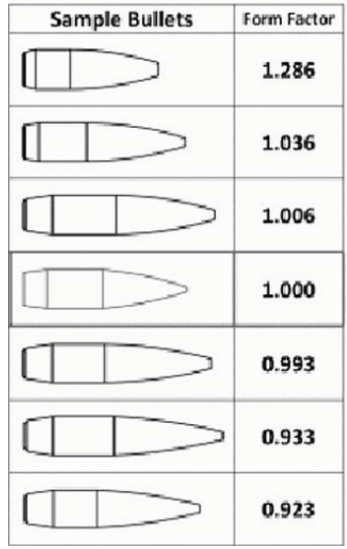

Fig. VI-5

Form factor, for shapes, of some jacketted spitzer Bullets

In addition to the shape, the uniformity of the projectile structure is also an important factor affecting the trajectory. The centre of shape must coincide with the centre of gravity. If they do not superimpose, the projectile vibrates during its flight. The trajectory is irregular. It has been estimated that if the two centres are apart only by 0.002 centimetres, the projectile (in case of a .303 bullet) will strike 25 centimetres away from the expected point on the target, at 500 metres.

Non-uniformity in the structure crops up due to varying thickness of the envelope (jacket) of the projectile, the defective mould of the lead core or presence of air (or gas) bubbles in the projectile.

Armour piercing, tracer or streamlined bullets do not 'set up' in the barrel properly. They may fail to fill the grooves. Thus, not only gases escape but the projectile also becomes unstable affecting the trajectory.

2.13 Sectional Density

The sectional density (SD) of a projectile is given by:—

$$\mathbf{SD = \frac{W}{d2}}$$

[Here: W = weight of the projectile, and

d^2 = cross-sectional diameter square]

The efficiency of the flight of the projectile greatly depends upon its sectional density. The greater is the sectional density the better is the efficiency. It is against this background that lead is used for the construction of most of the projectiles.

2.14 Ballistic Coefficient

'C' denotes the ballistic coefficient. It is the index of the ability of the projectile to overcome air resistance. It is given by:—

$$C = \frac{\text{Sectional Density SD}}{\text{Coeffecient of reduction (n)}} \quad \frac{SD}{= nd^2}$$

In case of .303 Mark VII bullets, where form factor is taken as 1, n = 1, W= 174 grains and diameter d =0.303, the co-efficient 'C' is:—

$$C = SD = \frac{W}{d2} = .271$$

2.15 Influence of Earth

The influence of the earth acts mainly in the form of the gravitational pull. As soon as the projectile leaves the muzzle of a firearm, it starts dropping. The projectile can never hit a target above the line of departure. The amount of drop after any given interval of time, from the line of fire, as already is given by:—

$D = 1/2\ gt^2$ (for vacuum trajectories)

Thus, the projectile drops about 5 metres in its first second and about 15 metres in the next second. However, these drops in the projectile do not become disastrous. Firstly, the projectile moves at a great speed.[1] It traverses the useful range (about 600 metres) in the first second. Secondly, the drop is compensated by firing the projectile at an angle, the sights are so adjusted that the drop of the projectile is compensated exactly at the given range. For example, if the drop at 100 metres is about five centimetres, the sight is adjusted at 100 metres range to lift the line of fire upward to give an angle of about one minute. The projectile would strike about five centimetres higher if there were no drop. As there is a drop of five centimetres at this range, the projectile now hits the bull's eye.

It has been observed that in actual practice the gravitational pull is somewhat less and is dependent upon the velocity of the projectile. The value of the constant 'g' is, therefore, modified.

The projectile drop is defined the vertical distance between the line of departure and the trajectory at the given point. Determination of the drop is useful in ballistic computations for the construction of the trajectories and the fixing the elevation angle of the sights of the firearms to hit the target at long distances.

2.16 Air Resistance

Air resistance affects the trajectory of a projectile in two ways.

1. Air resistance retards/accelerate the velocity of the projectile.
2. The wind tends to drift the projectile in the direction it is blowing.

2.17 Retardation

The net retardation of a projectile due to the air resistance is simply fantastic. It is unbelievable. For example, a Mark VII .303 projectiles fired at an angle of

1. The velocity of a 5.56 mm bullet is 890 **m/s** at 25 m from the muzzle.

45° would travel about sixty-five kilometres in vacuum, whereas it would travel four kilometres only in air. It is about one-sixteenth of the vacuum range. The air resistance reduces the range to about six per cent of the vacuum range.

The retardation due to air depends upon:—

1. The velocity of the projectile.
2. The shape of the projectile.
3. The density of air.
4. The temperature of the atmosphere.

We have already considered the effect of the shape of the projectile. It is proposed to consider the effect of the other factors.

2.18 Velocity

The retardation, by the air, due to the velocity of the projectile, Newton thought, is proportional to the square of the velocity. This has been found to hold good only for subsonic velocities. When the velocity of the projectile corresponds to velocity of the sound, there is a sudden tremendous increase in the air resistance. However, it varies at various ranges.

In view of the above changes in the resistance, there is no single equation, which holds good for the entire range. However, the retardation of projectiles due to air resistance may be expressed by the formula:—

$$R = AVn$$

R = retardation. 'A' and 'n' are constants, varying with the velocity zones.

Table VI-5

EFFECT OF VELOCITY ON AIR RESISTANCE

Velocity Range (in m/s)	0 to 250	250 to 300	300 to 375[1]	375 to 425	425 to 550	550 to 800	800 to 1100
n	2	3	?	3	2	1.7	1.55

The air resistance, in addition, has the following effects on the flight of the projectile:—

a. Reduces the maximum range.
b. Increase the time of flight.
c. Increases the drop at various ranges.

1. The air resistance increase in this range is tremendous. The value of 'n' varies from 3 to 13.

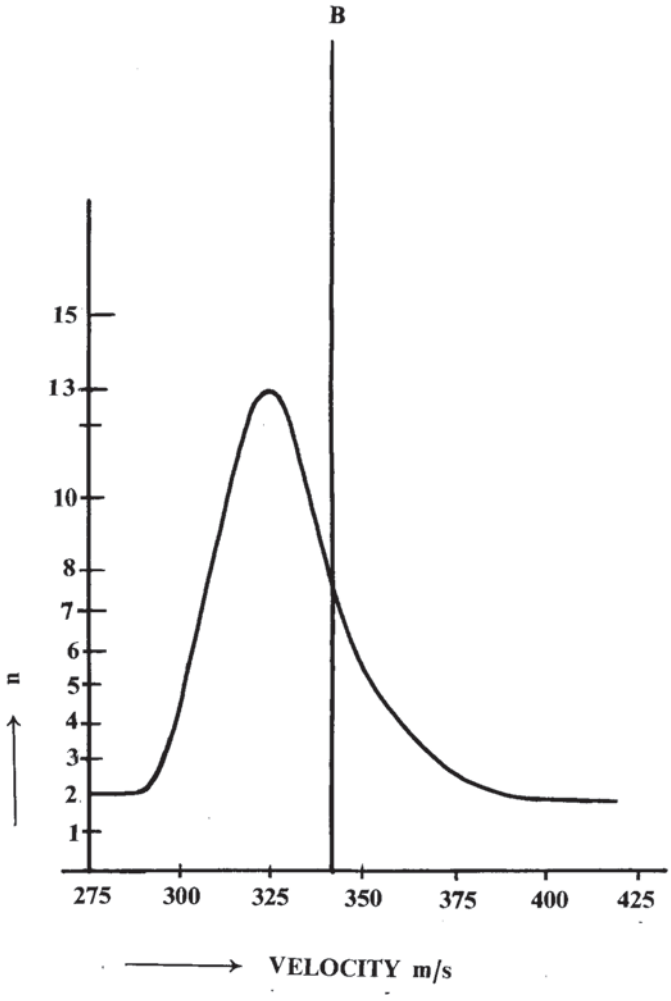

Fig. VI-6

When the projectile approaches the velocity of sound, the air resistance increases tremendously. The value of 'n' (in formula $R = AV^n$) is about 13, near the velocity of sound.

2.19 Density and Temperature

The density of the air changes with altitude and temperature. The thinner the air, the lesser will be the air resistance. Consequently, at higher altitudes the velocity at various ranges should be greater than at sea level. However, this facto is neutralised by the lower temperature prevailing at higher altitudes. The lower temperature tends to give lower muzzle velocities.

The higher temperature of the atmosphere tends to decrease the air resistance. Besides, at higher temperatures, the ammunition develops somewhat higher velocities. Consequently, the net effect is that at higher temperatures there is increase in the velocities and in the extreme ranges.

2.20 Measurement

The measurement of air resistance is neither easy, nor accurate. It is estimated indirectly. A number of shots are fired on the ballistic pendulum placed at various ranges. The remaining velocities are obtained from those tests. The retardations are calculated from the muzzle velocities, the remaining velocities and the other determinants with the above formula.

2.21 Wind Deflection

Wind affects the motion of the projectile in its path.

1. If the motion of air is in the same direction, it adds to the velocity of the projectile.
2. If it is blowing against the projectile, it reduces the velocity.
3. If it is blowing from any other side or at an angle, it not only changes the velocity but it also changes the direction of the projectile, called horizontal deflection. The main player to for the deflection is the drag which the vacuum behind the projectile causes. Higher the velocity, greater is the drag/deflection. The point of impact on the target is changed.
4. It may also cause aerodynamic jump.
5. It affects the spindrift.

The net deflection is given by:

Deflection = t x V Cos w

[Here w = Angle at which the wind acts, V = Velocity of the wind,
t = Time for which the wind acts.]

Firing Guns in the Air

The firing of the guns in the air is a frequent phenomenon. For example,

a. Police fire guns in the air to disperse crowds.
b. People fire weapons to celebrate various occasions like festival, victory, marriage, etc.
c. Experts fire firearms in the air to obtain test cartridges cases.

Firing in the air does not create trouble most of the time, but sometimes they may hit a person and cause injuries. These injuries are mostly non-fatal. Fatalities do occur only when the gun is fired at an angle. Alternatively, the bullet ricochets from some object coming in the path of the projectile.

Likewise, the problems of injuries of falling projectiles are rare. It occurs only in cases of high power service rifles. These projectiles have terminal velocities, which can cause serious injuries. Some of the terminal velocities have been calculated through ballistics computer programming by Hang. The terminal velocities for some service rifles are:

Table VI-6

Rifle	*Terminal velocity m/s*
.30 – 06	294
.30 – 30	284
7.62 mm x 39	264

3. RICOCHET[1]

When a projectiles strike a surface at low angles, they ricochet. That is, they change their direction, after striking the surface. In all firings, where projectiles ricochet, the angle of elevation is low. Consequently, the striking angles are also low. The projectiles, therefore, have ample chances to ricochet. They pose quite serious problems in forensic ballistics, sometimes.

The following information about ricochet may be noted:

1. Ricochet takes place only when the angle of elevation is low.
2. The angle of incidence is usually greater than the angle of ricochet (deflection); the angle at which the projectile flies after ricochet. However, some interaction at the ricochet site may determine the angle of ricochet.
3. The critical angle[2] depends upon the structure of the projectile and the ricocheting surface characteristics.
4. A ricochet bullet loses stability and tumbles in its path after ricochet.
5. The projectile loses some energy/velocity in after ricochet. The loss may be substantial, up to 35 %.
6. The ricocheted projectile picks up surface material from where it has ricocheted. The material can help identify the site. Likewise, the contact surface of ricochet also retains traces of projectile materials, which can help to identify the projectile. However if the projectile has ricocheted from water, no trace material can be located.
7. The projectiles, especially high velocity projectiles, sometimes break while ricocheting.
8. Ricocheted bullet wounds do not conform to shape and size the usual wounds created by the projectile. The deformity of the projectile will affect the shape of the wound. Likewise, the remaining energy/velocity will determine the severity of the tissue damage.

The phenomenon of ricochet has often confused the police and nonprofessionals. The confusion is:

1. Ricocheted projectile should lose energy at the ricochet site and should not cause fatal wounds. It is not so. The projectiles (like .303) retain enough velocity/energy to cause extensive and often fatal injuries.
2. The angle and the direction at which the ricocheted projectile flies, is unpredictable. They can injure a person at unsuspected/unpredictable places.
3. A ricocheted bullet may strike nose-onward, side-onward, base-forward or in any of the intermediate positions. It is sometimes difficult to figure out the nature of firearm/projectile/range/direction, which caused the wound.

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1. Dr. M. Jauhari and M.S. Rao, former Directors, CFSL, Kolkata, have investigated many facets of ricochet.
2. It is the maximum angle at which ricochet can take place from that surface.

4. SHOTGUN BALLISTICS

A shotgun is a short-range firearm. It is highly destructive at short ranges, though it is almost ineffective beyond 100 metres. It, ordinarily, fires pellet charge, which spread in an increasing area with increasing range. The aim, therefore, needs not be so critically accurate. It is a weapon of choice for small games, up to a range of about fifty metres.

The main elements of the shotgun ballistics are the firearm, the projectiles, their patterns, the striking velocity/energy and the wounding power.

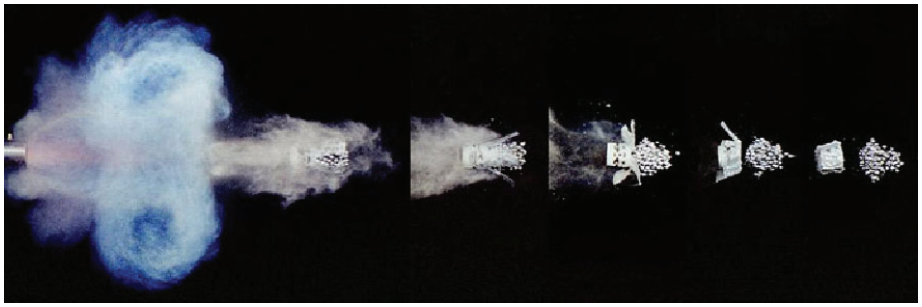


Fig. VI-7

Flight of the ejecta of a modern fired shotgun cartridge near the muzzle

4.1 Shotgun

Shotguns are named by the size of the bore. Thus, we have 8 bore, 10 bore, 12 bore, 16 bore, 20 bore and other bore guns. They have varying diameters. The 12-bore shotgun is the most popular shotgun. It strikes a balance between the weight and the effectiveness of the weapons.

Formerly, the length of the barrel was believed to add to the wounding power of a firearm. Most of the shotguns, therefore, had long barrels, over 90 cm. A lot of experimental research has shown that:

1. Barrel length should be such that the combustion of the propellants used is complete before the projectile leaves the muzzle. It has been found that the combustion is complete in a 40 cm barrel in small arms.
2. The additional lengths do not add significantly to the velocity/energy of the projectile. Now there is no material difference in the velocities and hence in the striking power of the barrel lengths have been reduced.[1] Now modern shotguns have barrel length about 75 cm[2] or less.
3. Long barrel provided larger site circle and provided better aim accuracy. Telescopic site now provide better aim.

---

1. *The difference in the muzzle velocities of the projectile fired under similar conditions, from the guns having barrel lengths 75 and 65 cm was only 2 m/s. The difference in striking velocities, at 50 metres, would be less than 0.7 m/s.
2. The barrel length of 12 bore 10F Pump Action gun is 478 or 510 mm (= 18″ and 20″) respectively.

4.2 Strength of the Firearm

Pressure of the gases formed in the barrel drives the ejecta including the projectiles. Higher the pressure greater is the velocity/energy/wounding power of a shot/projectiles. High pressure can be created by increasing the propellant charge. The strength/safety of the gun however, limits the increase of the propellant. Higher velocities are, therefore, achieved through progressive powders. They give sustained pressures and consequently increase the muzzle velocities of the projectiles without increasing the peak (highest) pressure.

4.3 Jump and Vibration

The jump and vibrations in a shotgun may disturb aim. They have to be controlled. When a gun is fired, the breech jumps upward. Consequently, the muzzle dips downward. By the time the projectile charge reaches the muzzle, the reaction wave vibrations push the muzzle somewhat upward and the projectiles, theoretically, strike the target at a slightly higher point to the aimed site. Ordinarily, the jump is only slight. It is compensated. In double-barrelled guns, there are sideways vibrations also. Contrary to popular belief, heavier guns are steadier than the lighter ones.

The time interval from the pressing of the trigger to the ejection of projectiles in shotguns is about 0.008 seconds. The personal factor, therefore, matters little unless the person is nervous.

4.4 Recoil and Shotgun Weight

Recoil Control is essential to ensure inconvenience or injury to the shooter. When the recoil velocity is less than 3 m/s, the recoil is not bothersome. It is tolerable up to a velocity of 4.5 m/s. It becomes troublesome beyond 5.5 m/s.

The recoil velocity permits the calculations of the desirable approximate weight of a shotgun:—

Forward Momentum M_1V_1 = Backward momentum M_2V_2

If M_1 is the mass of the ejecta, V_1= muzzle velocity, M_2 the mass of the gun and V_2 the recoil velocity say, 4.5 units, we have:

$400 \times 35/1000 = M_2 \times 4.5$

Or, M_2 = 400 X 35/4.5 X 1000

= 3.1 Kg

= 3 Kg (Approx.)

Lighter guns are becoming popular.[1] A suitable compensator, however, reduces the recoil.

4.5 Patterns

A shotgun fires multi-projectiles cartridges/ammunition usually. The projectiles start spreading soon after they come out of the muzzle. The spread of the pellets covers increasing areas of the target with the increasing range.

1. The weight of the 12 bore 10F Pump Action gun is 3.05 kg.

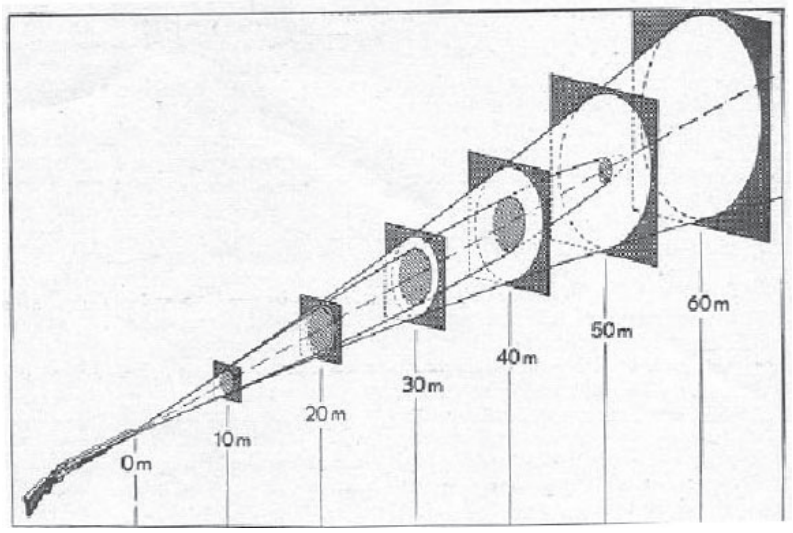


Fig. VI-8

Increased target spread area with increased range

The spread of pellets also varies with the choke characteristics of the barrel. The choke not only reduces the spread but it also makes it uniform.

The spread of the projectiles ensure that some pellets will hit of the target. The aim is, therefore, not as critical in shotgun shooting as in the case of other firearms.

The density of the hit indicates the quality/effectiveness of a pattern. It is expressed in terms of percentage of the total number of pellets falling in a circle of 75 cm (30″) diameter at a range of 36 metres (40 yards).

The densities given by standard 12-bore gun barrels of different chokes, at various ranges are given below:

Table VI-7

PERCENTAGE OF PELLETS HITTING THE TARGET, IN 75 CM CIRCLE, AT VARIOUS RANGES

Range in metres	*Full choke*	*½ choke*	*¼ choke*	*Improved cylinder*	*True cylinder*
30	90	76	70	64	53
35	74	64	58	53	43
40	62	54	48	43	35
45	51	43	39	34	28
50	41	34	31	27	22
55	32	27	25	22	18

Similar densities in the patterns given by guns of different bores can be achieved by having different choke characteristics and different loads. A comparison between the 12 and the 16 bore barrels may be noted.

4.6 Stringing

In stringing, the pellets of a fired shot do not travel in one plane. Instead, some pellets follow behind others, in a string like formation. The usual string length of a charge is roughly 15 % of the range. However, in some cases the first and the last pellets may be one-third of the range apart. Progressive powders reduce the length of stringing to about 10 per cent of the range. The use of sleeves for the projectile charges has reduced the stringing length considerably.

Long strings are undesirable as they reduce the wounding power. Short strings increase the wounding power.

The main causes of the stringing are unequal sizes and varying structure of the projectiles, unequal friction and different deformations of the projectiles. These factors cause the velocity differences in the pellets of the same cartridge and cause stringing.

The density of pattern is also affected. The extent of reduction is dependent upon the range and non-uniformity of the pellets. Loss of density in pellet pattern in full choke is about 5 and 15 per cent at thirty and forty metres respectively.

4.7 Striking Velocity

Striking velocity of a projectile is its velocity at the time it hits the target. This entity is mainly responsible for its wounding power. Its determination therefore, gives the effectiveness of the firearm ammunition and firing system. The table below gives the striking velocities of the pellets of different sizes at various ranges.

Table VI-8

STRIKING VELOCITIES OF A STANDARD 12 BORE CARTRIDGE.[1]

Size of	*Striking velocities (m/s) at metres*							
shots	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*
1	278	260	245	228	215	200	175	162
2	276	257	241	224	209	194	169	156
3	272	253	236	219	203	188	162	150
4	269	249	231	214	197	181	155	142
5	265	244	224	205	188	171	145	132
6	261	239	219	199	180	163	136	123
7	257	234	212	191	172	154	127	113

It has been estimated that a bird game needs a transfer of about 0.11 m-Kg (.8 foot-pounds) energy to ensure a kill. This is a rough estimate as it is not possible to assign any definite value. The value will vary with the site hit and from one game to the other. It is, however, a useful value for comparison purposes. Based on the figure it is possible to calculate the minimum effective velocities required by the pellets of various sizes. They are given in the table below:

1. Muzzle Velocity 325 m/s.

Table VI-9

MINIMUM EFFECTIVE VELOCITIES FOR KILL

Shot size	A	BB	B	1	2	3	4	5	6	7	8	9
Velocity m/s	65	72	77	86	94	102	112	130	144	161	186	210

The energy of a projectile required to incapacitate (put out of action) a person is about 5.5 to 8 m-Kg. Therefore, the energy transfer required is about 50 times or more for human (target) than that of a bird. Thus, if one small pellet can kill a bird, about 50 pellets are required to kill a man. It is in this context that the shotgun is termed only a short-range firearm. Only at short range, a number of pellets can hit a person and incapacitate the person.

Most of the shotgun cartridges manufactured give muzzle velocities close to the velocity of sound (400 m/s). Consequently, the striking velocities are usually in sub-sonic zone.

The rate of loss of the velocities (retardation) is high. The loss is due to:—

1. **The air resistance.** The retardation due to the air resistance, as already seen, is considerable.

   In practice, it has been observed that if the muzzle velocity of a No. 6 projectile is increased by 40 metres per second, then the net gain in the striking velocity of the shot at 50 metres will only be 13 m/s.

2. **Poor form factor.** The shotgun projectiles are mostly spherical in shape. They are notoriously poor in retaining the velocities. The ballistic coefficient (C) which measures the ability of a projectile to retain the velocity, as seen already, is given by:—

   $$\mathbf{C = W/D^2n}$$

   [Whereas the value of 'n' (form factor) for cylindro-conoidal bullets is 1. It is 2.3 for spheres].

Table VI-10

BALLISTIC COEFFICIENT (C) FOR VARIOUS SHOT SIZES

Shots	LG	SG	AA	A	AB	BB	1	2	3	4	5	6
C	.035	.031	.018	.017	.015	.014	.013	.0125	.012	.011	.010	.0096

3. ***The size of a pellet.*** The rate of loss of velocity is also controlled by the size of the projectile. Smaller the size, greater is the retardation. Thus, the number 2 pellet retains lesser velocity than the LG shot! The former is, more or less, harmless at 100 metres; the latter is dangerous even at 1000 metres, when fired at an elevation of 30°. A single projectile (ball charge) fired from a shotgun is still better in retaining the velocities. However, they suffer from the other defects: 10 cartridges (containing lead balls) fired from a range of 30 metres will cover an area of more than one metre square at the target!

The cylindrical projectiles, especially those given spin, as already seen, are accurate for a much longer distance and lose velocity at a much lower rate.

The following factors also affect the velocities of shotgun projectiles. The effects are of theoretical interest only.

(1) ***Barrel length***. If the barrel length is below 40 cm, the muzzle velocities are low. If the barrel length is more than 40 cm the gain is only marginal. There may again be reduction in the muzzle velocities if the barrel is too long.

(2) ***Choke.*** A full choke barrel increases the muzzle velocity by about 6 m/s.

(3) ***Weight of the charge***. If the shot-charge is decreased by about two grams (~ 7%), the gain in the muzzle velocity is about 20 m/s.

(4) ***Shot size.*** The smaller sized pellets acquire greater muzzle velocities.

(5) ***Density of loading.*** It may give differences in the muzzle velocities up to 20 m/s.

(6) ***Progressive powders***. They produce better velocities for the same pressures.

(7) ***Bore diameter***. For the same pressures, the projectiles in a larger bore have greater velocities.

4.8 Extreme Range

The extreme range 'R' of a shotgun projectile fired at 30° elevation (standard ammunition and firearm) can be calculated by:—

$$\mathbf{R = 1500/N^{1/3}}$$

[Here, R is range, N is number of pellets per 28.35 g.]

Another simple formula, for extreme range is:—

$$\mathbf{R = 2200 \times Dp}$$

[Here, R is range in yards, Dp is pellet diameter]

The reduced velocity Vd of a spherical ball of ballistic coefficient 'C', at a distance of D, with a muzzle velocity V0, is given by:—

$$\mathbf{D = C \times \log [V0/Vd]}$$

5. ESCAPE VELOCITY

The projectiles flying at very high velocities overcome the pull of the earth. Thus, a missile flying over eight Km/s will orbit the earth in a circle. If the speed is over eleven Km/s, the object will fly away into space and will never return to earth. The velocity at which an object escapes the gravitational pull is called the escape velocity. It is given by:—

$$\mathbf{\text{Escape Velocity} = (2\ g\ R)^{1/2}.}$$

[Here, g = gravitational acceleration, R= Earth's Radius.]

The rotation of the earth, round its own axis tends to hurl away the projectile. However, the effect is too little to affect practically the small arm ammunition trajectories.

TERMINAL BALLISTICS

SYNOPSIS

1. **GENERAL**
2. **WOUNDING MECHANISM**
3. **DETERMINERS**
   - 3.1 Target
   - 3.2 Projectiles
   - 3.3 Velocity
   - 3.4 Constructional Features
   - 3.5 Range
4. **BULLET RESISTANT BODY ARMOUR**

7

TERMINAL BALLISTICS

1. GENERAL

Terminal Ballistics is the study of impact of a moving projectile at the impacted site, inside the target, if it has penetrated the target and at its exit point, if it has passed through the target. The science also involves the study of the projectile after its exit from the target. In short, Terminal Ballistics is the study of the aftermath phenomena of a projectile and its target after the hit.

Forensic Terminal Ballistics helps to understand the wounding phenomena in shooting cases. It is taken, therefore, as synonymous to Wound Ballistics for practical purpose. The two phrases have been used interchangeably in the following discussion.

2. WOUNDING MECHANISM

When a projectile strikes human body, it depresses and compresses the skin, flesh and the bone underneath. The continued pressure stretches them beyond the elastic limits and projectile creates a hole. The stretched skin regains its normal state after the projectile has crossed the skin and entered into the body. The diameter of hole on the skin, therefore, appears, on the non-stretched skin somewhat smaller than the diameter of the projectile, which created the wound.

The reduction of diameter of the projectile hole on the body of victim is dependent upon the extent of the stretching limit of the skin. Ordinarily it should not exceed ten percent of bullet diameter, in most of the cases.

The minimum velocity (threshold velocity) required to penetrate has been estimated. It is:

a. 40 to 50 m/s for human skin.

b. About 60 m/s for a bone.

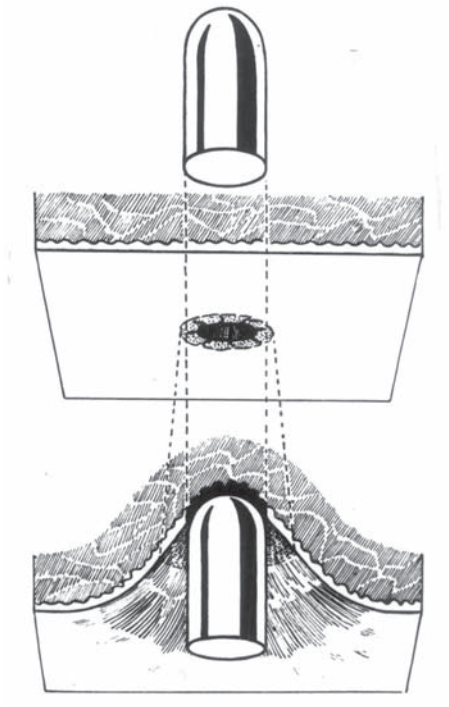


Fig. VII-1

Mechanism of creation of entrance wound.

The entering bullet stretches the skin and ordinarily causes wound which apparently looks smaller in diameter due to elasticity of the skin.

The projectile, after entry, continues its onward progress until it leaves the body through an exit hole. If its energy is spent before exiting in overcoming the resistance from the clothes, skin, flesh and bones, it is lodged at the end of the tunnel.

Ordinarily, a projectile injury has three parts:

a. Entrance wound,

b. Exit wound, and

c. Track in between.

When there is no exit wound(s), the projectiles or their fragments remain in the body. In some cases, the projectiles may enter/exit through natural orifices like mouth, anus, eyes, ears etc making the injuries invisible.

In a murder case, the body of the victim was found after many days. The visual examination revealed only one wound. X-ray did not indicate any foreign body inside. Probe revealed the second injury. In fact, the hidden injury (in the palate) was the entrance wound. ***(CH)***

Some unknown culprits murdered an assistant sub-inspector of police. A rifle projectile hit him at the back of his neck. There was no visible exit wound. The

projectile was thought to be inside the body. Thorough X-ray screening was done but to no avail. On probing, the track was found to end in the mouth. Apparently, the projectile had escaped through the mouth! ***(CH)***

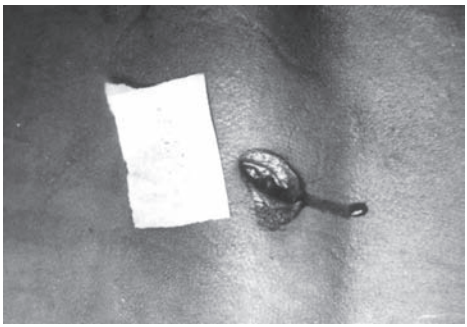


Fig. VII-2

Entrance hole on the chest, of a .38 revolver jacketted bullet from a close range. The shape of the entrance is oval-almost approaching 'key hole' formation.

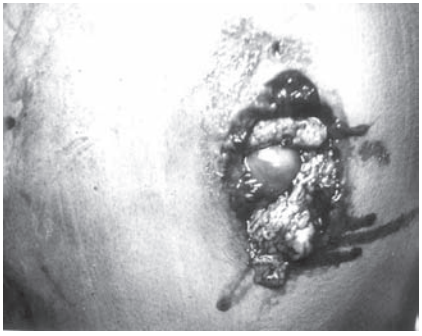


Fig. VII-3

The exit wound of the same projectile on the back. The dimensions of the wound are far greater than the entrance wound. The two photographs are to the same scale.

Firearm entrance wounds may be circular, oval, ragged, key-shaped or explosive. The explosive wounds are sometimes confused with wounds caused in explosions. Usually, only high velocity projectiles cause them. Shotgun fire at the head, from contact or near contact, position may also cause explosive wounds.

Ordinarily, entry wounds have somewhat smaller diameters than the diameters of the hitting projectiles. Sometimes they may have equal or even larger diameters.

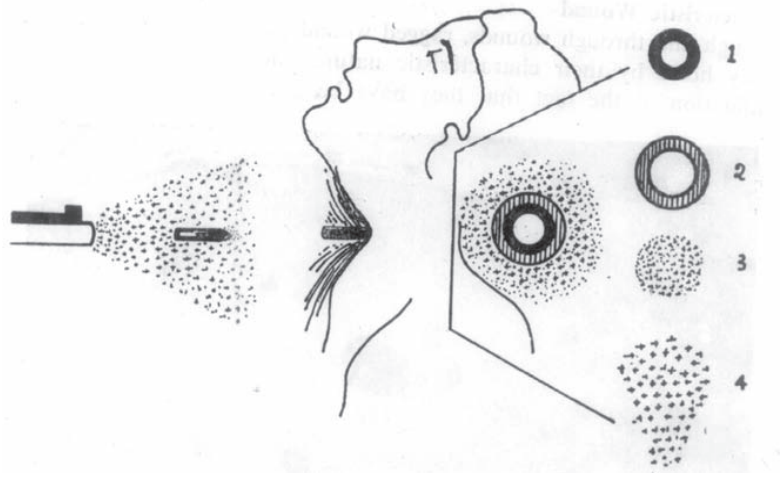


Fig. VII-4

The mechanism of formation of firearm injuries and of formation of extraneous deposits.

The wound is characterised by:—

(1) Dirt ring due to the deposit of dirt (grease, graphite, soil etc.).

(2) Contusion ring formed by the impact on the edges, by the entering projectile.

(3) Smoke particles deposit around the wound—close range phenomena.

(4) Tattooing due to embedding of semi-burnt or unburnt powder particles—close range phenomena.

Fig. VII-5

Correct recording of injury (scale not shown)

Indicates external view of the entrance wound.

The exit wounds are frequently irregular, rarely circular or like a foxhole. The dimensions are, ordinarily larger than those of the entrance wound or the diameter of the passing projectile. If the projectile fragments, the fragments may cause multiple exit wounds, usually of smaller sizes.

The internal track may be a straight tunnel or it may be zigzag, due to deflection of the projectiles. Sometimes, due to fragmentation of the projectile multi-track wounding is caused inside. Formation of secondary projectiles may also form additional track(s).

At times there may be a small entrance wound, approximately equal to the diameter of the projectile, but inside, a tunnel, far larger, many times the diameter of the projectile, is observed. The exit wound is also much larger than the size of the projectile. Such wounds are called explosive wounds. High velocity projectiles cause these explosive wounds..

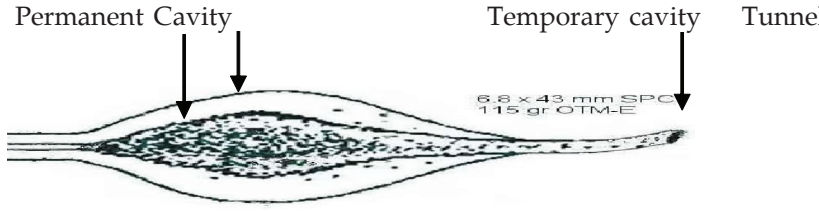


Fig. VII-6

Cavity formation (Schematic) with a high velocity projectile

Shotgun shots, fired from contact or near contact range, also cause explosive wounds. Here the entire ejecta (the projectiles, wads, GSR, gases, etc.) enter into the body *en masse* and expand inside. If the space inside is limited, the ejecta explode the body tissues around.

Sometimes gunshot fires cause extraordinary injuries like incisions, abrasions and contusions. They normally do not have the usual three parts. They are rare and are often confused with the injuries from blunt or sharp-edged weapons.

Projectile damage human body tissues in three ways:

1. They cut, crush and contuse body parts. The processes start at the entry, continue in the tunnel and end up at the exit point. Many factors influence the extent of damage, including the velocity and the structure of the projectile and the body part hit.
2. The projectiles, with high velocities, form temporary and permanent cavities. There is extensive damage to the nearby tissue due to repeated pulsations created in the cavity and the gyration (spinning) of the projectiles. There is hardly any cavitation when the velocity of the projectile is low.
3. The projectiles also suffer yaw. It increases the area of contact of the projectile with the target and thus, the extent of the damage of the projectile, to the tissues increases significantly.
4. The projectile, in addition, compresses the body water (hydrostatic pressure). It is transmitted to the various body parts. It may impart significant damage to the nearby tissues and in some cases cause shock[1].

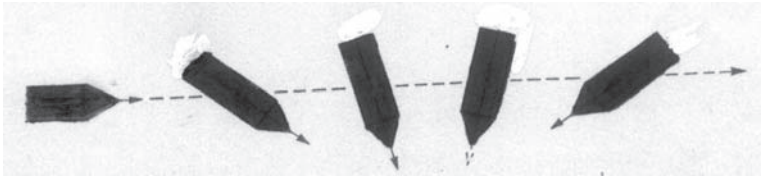


Fig. VII-7

Yaw causes turning of the bullet and enhances wounding power of the projectile.

1. Shock waves compress the medium and travel ahead of the bullet, as well as to the sides. These waves last only a few microseconds. Low velocity projectiles do not cause extensive destruction. High velocity projectiles generate high pressure shock waves (can reach up to 200 atmospheres of pressure). However, bone fractures from the shock waves and cavitation are rare. The pressure wave can produce concussive effect in humans, to cause neurological.

3. DETERMINERS

Many factors influence Terminal Ballistics, aka, Wound Ballistics, including the following:

3.1 Target

In wound Ballistics, human (animal or beast) body is the target. However, here we are concerned with human body. It is about 80% water. The structure is not uniform. At places, there are bones, at other places there are voids, veins, nerves, muscles, organs or blood vessels. Thus, the vulnerability for wounding and the extent of damage by the same projectile, with the same ballistics, is varied. Some useful information about human body, *vis-à-vis* wound ballistics, is noteworthy:

1. The human body is covered with skin. On average, its surface area is about 5000 cm2.
2. About 43% surface of the human body area (about 2150 cm2) covers sensitive body parts, which have organs, cavities, nerves, blood vessels, etc. underneath. They are damaged comparatively easily and cause serious, often fatal injuries.
3. The average thickness of the protective tissues on the frontal part of the human body is 0.6 cm and that of the backside tissues is about 3.3 cm (almost 5 times). Thus, frontal injuries cause greater damage than the injury on the back.
4. The difference in the wounding effect is realised only when the velocity of the projectile is around the threshold velocities. With high velocity projectiles, the difference is not noticeable.
5. The body part hit plays an important part. If the projectile cuts the skin only, in a grazing injury, it does not do much harm. Likewise, a hit on a finger, a toe or a through and through injury in the leg calf/ thigh/arm muscles of a person may not endanger life.
6. If a projectile injures the vital parts of the body (the brain, the heart, the spinal cord, the lungs, the liver or aorta, etc.) the person is incapacitated (stopped) almost at once. Often these injuries are fatal. It is against this background that the elephant hunters try to reach the brain of the game, though the target area is small.

The part of the body hit is also responsible for the extent of shock[1]. The shocking power of a projectile varies from person to person unless the vital parts are hit and injured. Emotional upset (fright!) plays an equally important part if not more. This explains the extraordinary bravery shown by Pathans in Anglo-Afghan Wars. Mark VI .303 projectiles used against the Pathans had the effective striking velocities about 600 m/s. They did not cause explosive wounds

1. It is difficult to describe and understand shock completely in terms of physical phenomena. Physical injury is principally responsible for the shock. However, it also depends upon the victim's emotional disturbance, fright or pain. The fall of blood pressure is the main indicator of shock. This drop is due to loss of blood or from extreme pain or fright. The latter dilates the blood vessels and causes sudden drop. The shock may be reversible or irreversible depending upon the degree of the shock and its duration.

to cause sufficient shock (in physical sense). The Pathans, hit at non-vital parts, continued fighting.

The most sensitive regions of the body for incapacitating wounds, as already seen, are:—

- **Head.** If a projectile penetrates the skull bone and enters the brain, the injury is fatal, usually.
- **Heart and blood vessels.** If these organs are hit, the copious bleeding immediately disables the man and often proves fatal.
- **Lungs/Liver/thorax.** Injuries to these organs cause immediate disability and immediate incapacitation and frequently prove fatal.

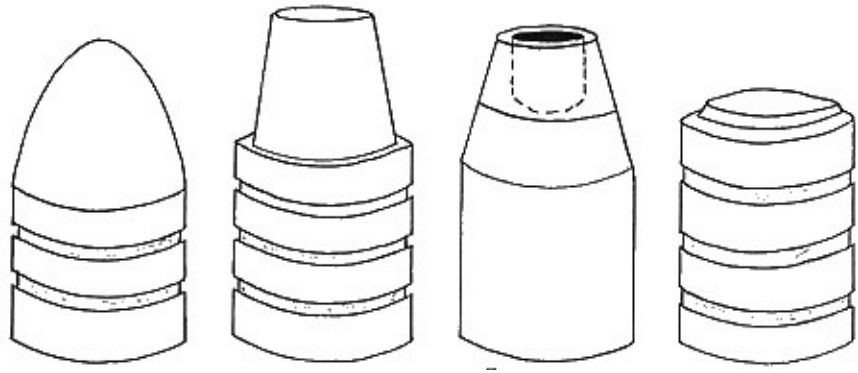
3.2 Projectiles[1]

Projectiles are the *prima donna* in the field of wound ballistics as they are cause injuries. There is continued research to create projectiles, which may give desired ballistics. Usually the following types of projectiles are met with in criminal investigations:

(1) **Projectiles for human target**.[2] They have controlled penetration, usually through deformation (expansion). They, ordinarily, do not pass through the body and the whole kinetin energy of the projectile is converted into wounding power, causing serious wounds.

The effective wounding effect of a projectile is achieved through following:

a. **Round/Flat point projectiles.** A wide, flat tip increases the effective impact area and thus transfers almost the whole of its kinetic energy into wounding power.



1. Round Nose, 2. Semi-wad cutter, 3 hollow point Wad cutter with flat nose

Fig. VII-8

Lead projectiles sometimes used in low velocity ammunition for maximum tissue damage

1. The discussion relates mainly to projectile involved in forensics.
2. There is controversy whether these projectile disregard the Hague Convention or not. The convention is perhaps for war ammunition. USA army feels that the expanding bullet does not contravene the convention. All nations are using expanding bullets for their armed forces, to ensure proper stopping power.

b. **Expanding projectiles**. They expand of hitting the target, which facilitate transfer of bullet energy to the target and thus, create greater wounding effect. The expansion is achieved through creation of soft/ hollow point nose. They usually mushroom or break, which make them more effective.

c. **Frangible projectiles**. They break up on impact, which results in a huge increase in surface area. These bullets are made of small diameter lead pellets, placed in a thin copper shell and held in place by an epoxy or other adhesive.

d. **Fragmenting projectiles**. They are usually like hollow point projectiles but with deeper and larger cavities.

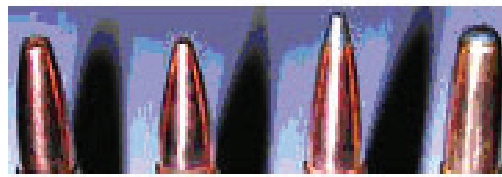


Fig. VII-9

Left to right: hollow point, FMJBT (Full Metal Jacketed Boat-Tailed), soft point, round nose

(2) **Projectile for deep penetration** (and maximum damage). They are used in military and big games ammunition. Forensic Ballistics experts come across them in terroristic cases mainly. Hunting is not legal in India.

Such projectiles:

- **Are fully jacketed**. Tip is not exposed; base may be exposed. Tip is usually made of softer material, for example Aluminum.
- **Have steel core**: wholly or partially.

Fig. VII-10

INSAS Cartridge and projectile for maximum damage and deep penetration

(3) **Projectiles Target Shooting**. They are special bullets used in shooting competitions. They have proper balance to eliminate wobbling and reduced projectile drag (through increased length of the projectile and reduced twist length in the barrel).

(4) **Stopping power of projectiles.** Stopping power is the ability of a projectile/firearm/other device to incapacitate the target (human/animal) to move or attack the shooter or other persons. The incapacitation may or may not cause death. The factors, which determine the stopping power of a projectile include:

1. Structural material and structure,
2. Shape weight, diameter, sectional density,
3. velocity,
4. penetration,
5. energy transfer for tissue damage,
6. fragmentation.

(5) **Hydrostatic shock**. A penetrating projectile, in addition to local effects in tissue caused by direct impact, can produce remote wounding and incapacitating effects in living targets through a hydraulic effect in their liquid-filled tissues.

(6) **Estimating Stopping Power.** For estimating/comparing stopping power, two formulae have come up they give idea of *inter se* stopping power of the projectiles/shots:

a. **Hatcher's formula**. He called it Relative Stopping Power (RSP):

RSP = Cross-sectional Area X Momentum X Shape factor

b. **Relative Incapacitation Factor (RIF).** It is USA's criminal justice department's formulation, based upon the nature of the target, hit distribution and Bullet's Terminal ballistics. The factors considered are:

a. Spin of the projectile.
b. Yaw of the projectile.
c. Twist effect.
d. Wobbling projectile.
e. Kinetic energy of the striking projectile.
f. Energy transferred to the target, wounding power of the projectile.
g. Range of fire.
h. Influence of ejecta.

3.3 Velocity

The velocity of a projectile has a great influence on the nature and extent of damage caused to the body tissues. The energy of a projectile is proportional to the square of the velocity. It is given by the formula:

E=1/2 MV2

If the velocity is double, the energy of the projectile becomes *four* times, if it is trebled, the energy of the projectile becomes *nine* times. Therefore, this great influence of the velocity has been exploited in the new military ammunition.

Most of the world's service rifles use high velocity projectiles with smaller diameter and lesser mass. For example, the Indian Government has changed the calibre of the service rifles. The new and old bullets have the following data:—

		New	**Old**
Diameter	=	5.56 mm	7.62 mm
Length	=	45 mm	51 mm
Weight	=	4.16 g.	9.35 g.
Muzzle Velocity	=	915 m/s	825 m/s

The formula**, (E=1/2 MV2**) does not tell the whole truth. When Mark VI .303 bullets did not stop the Pathans, the British used Dum-Dum bullets which were soft at the nose. They fragmented and caused extensive wounds.

The Dum-Dum bullet had no more energy than the standard Mark VI bullet[1]. However, in terms of lethality, it was far superior.

The same effect was achieved without softening the nose in the Mark VII bullet[2]. It usually caused 'explosive wounds'.

In INSAS 5.56 mm, ammunition the lethality has been enhanced by inserting two cores: one of lead and the other of steel. The bullets break up on hitting the target and thus lethality increases.

The wounding effect of projectiles fired from firearms, on velocity considerations, is studied in four velocity zones:

a. Velocities under 400 m/s
b. Velocities from 400 to 600 m/s
c. Velocities from 600 to 1100 m/s
d. Velocities beyond 1100 m/s

In the first velocity zone (**up to 400 m/s),** no abnormal wounding phenomenon is observed. The projectile does not fragment/deformed to any appreciable extent unless it strikes a bone. The extent of the deformation and the deflection, if any, depends upon the amount of resistance and the angle at which the projectile strikes. If expanding bullets are used, they cause more damage.

In the second zone (**400-600 m/s),** the projectile behaves midway between similar projectiles in the first and the third zones. The lead bullets and expanding bullets start mushrooming. The extent of the deformation depends upon the striking velocity, the constructional materials and features of the projectile and the resistance offered by the body (target) site. The tissue damage is greater,

1. Mark VI bullet weighed 13.95 gm. It had a muzzle velocity of about 600 m/s.
2. Mark VII bullet weighs 11.28 gm. Its muzzle velocity is 750 m/s.

because, the cross-sectional area (also called projection area) becomes greater as the projectile progresses forward. The projectile may or may not be retained inside the body. If it goes out, the exit wound is much larger than the entrance wound or the diameter of the projectile.

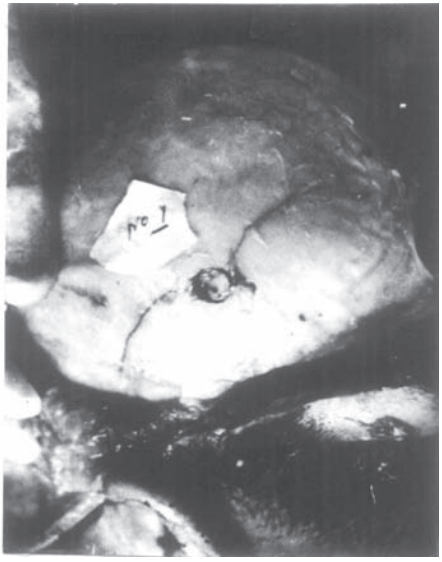


Fig. VII-11

Same (XII-3) entrance wound, shows extensive fracture of the skull bone.

Fig. VII-12

The exit wound to the same entrance wound (XII-4). Crater formation and larger dimensions are visible.

The most important and obvious wounding effect of the velocity of a projectile, in the third zone **(600-1100 m/s)** is to produce explosive wounds. There is no single cause of the formation of explosive wounds. The following explanations, however, are given:—

1. The high velocity projectile, while moving forward in the body, creates a vacuum behind it. The air behind rushes in at a terrific speed and disrupts the body tissues. This explanation alone is not sufficient. The explosive wounds are caused even on the targets kept in vacuum and the projectiles fired at the target without disturbing the vacuum.
2. The body parts hit by the projectile themselves become effective secondary missiles and cause extensive damage to the body.
3. The projectile fragments and these fragments cause extensive injuries. In some cases the projectiles do not fragment yet they cause explosive wounds.
4. The spinning motion of the projectile is very high[1]. The tissues, which meet the projectile, are set into motion and churned. These tissues,

1. For example, .303 Mark VII bullet spins at the rate of 200000 rpm at the muzzle. The loss of revolutions is about 10% per second.

in turn, tear off the adjoining tissues. The process inflicts injury on the tissues far beyond the immediate vicinity of the main track of the projectile.

The spinning motion alone cannot be responsible for explosive wounds as experiments with small non-spinning spheres at high velocities also produce explosive wounds. It is well established, however, that the wounding effect of a rotating bullet is far more extensive.

This is because the projectile deviates from the nose-onward position. The deviation (called 'Yaw') tendency is about 800 times in body tissues than in air. The projectile after a short passage in the tissues (say, 5 cm.) may consequently, be slanted by 50° to 90° to the line of fire.

Thus, the projection area (cross-sectional area of the bullet) will be many times the area when it is travelling in nose-onward position[1]. Besides, instead of passing through the body, blunt front of the bullet transfers its energy to the wounding process. The extent of transfer of energy and hence wounding effect is, therefore, many times more.

5. Experiments with high velocity projectiles fired in water, gel blocks, anaesthetised animals and cadavers have largely cleared the mechanism of their 'explosive effect'. They are found to have the following effects:

   (1) The projectile compresses the air in its front. It starts a shock wave. The intensity of the shock depends upon the velocity of the projectile and the energy transferred by the projectile to cause the shock wave. 0.5 cm. diameter steel sphere with a velocity of 1000 m/s causes a shock wave which compresses the body of the target with a pressure of about 45 atmospheres (46 Kg/cm.2) to 200 atmospheres, which alone is sufficient to kill a person. The shock waves are repetitive, but the intensity falls off almost immediately. The pressure fall varies with range.

   (2) The projectile forms a temporary cavity, which is many times larger in volume than the volume of its creating projectile. The volume depends upon the energy transferred by the projectile. It is 7.85 cc per M-Kg energy transferred to the tissues. The volume is temporary cavity is about 30 times the volume of the permanent cavity. This cavity formation and hydrostatic pressure are responsible for breaking bones and tearing muscles far away from the path of the projectile.

   The temporary cavity collapses after the passage of projectile in a short time but due to inertia it pulsates and it is only after a number of pulsations that the temporary cavity finally closes down to a permanent cavity. In the meanwhile, extensive damage is caused to the tissues.

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1. Projection area in nose onward position is, $A = \pi r^2$. Projection area in 90° yaws' $A = \frac{1}{2} \pi r^2$ where 'r' and 'l' are the radius and length of bullet.

(3) The major damage to the tissues is caused by the fast moving projectile, which compresses and cuts the tissues in front and on the sides causing the permanent cavity and the extravasation of the tissues along the tunnel (the permanent cavity). The cut tissues are thrown away from the track, while, the compressed tissues are violently thrown against each other. The process lacerates the tissues badly.

(4) The volumes of the permanent cavity and the zone of extravasation are 0.32 cc per M-Kg and 3.75 cc per M-Kg of the energy transferred by the projectile, respectively.

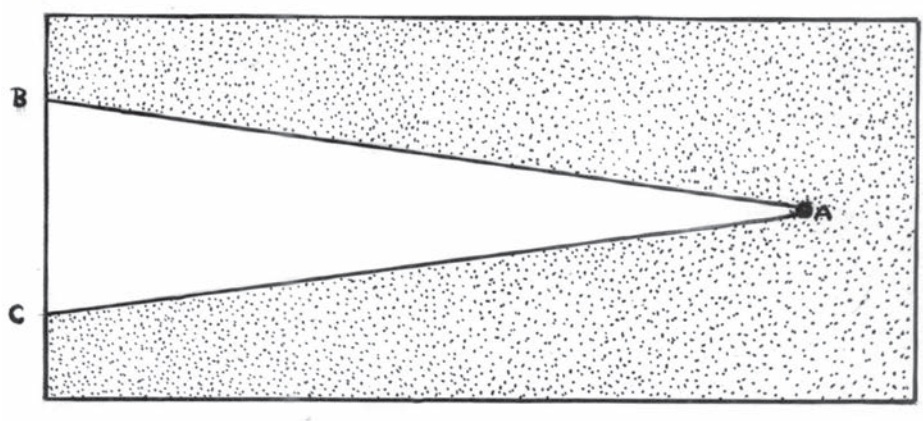

Fig. VII-13

Cavity formation by a high velocity projectile, sphere (A) in this case. The cavity ABC is many times the volume of the sphere.

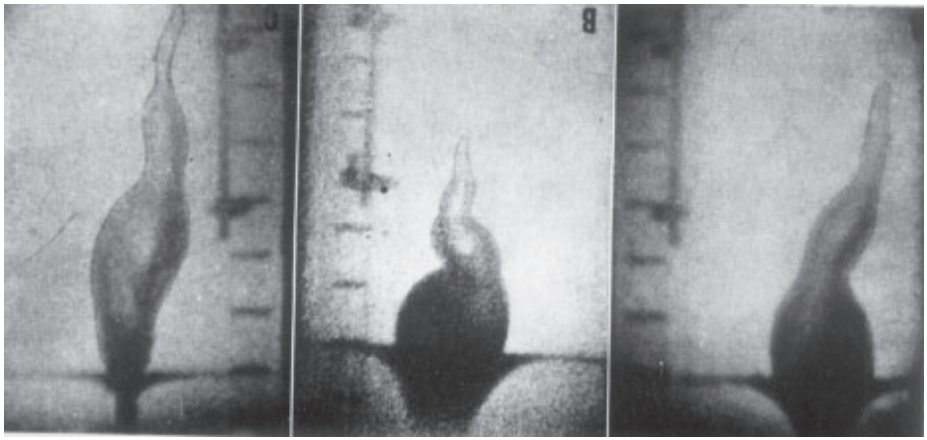

Fig. VII-14

Cavity creation by spinning projectiles of different shapes.

The 'Explosive' wounds are usually caused by the service and sporting rifles when their striking velocity is around above 600 m/s or above.

In the fourth zone, the velocity of the projectile is very high (**above 1100 m/s**). Very few cartridges are made which propel projectiles having striking velocities of the above order. Consequently, there is no detailed study of the wounding effects of such projectiles. The effect of the projectile on the game is, however said to be instantaneous death, as if the game has been struck by lightning. Whelan has reported a case where a projectile travelling at 1100 m/s hit a prairie dog in the right fore paw. It killed the dog right away.

A modern cartridge develops velocities between 200 to 1400 m/s if the propellant is allowed to burn in a confined space. If the expansion is not controlled, the projectile is pushed out as soon as the pressure inside the cartridge case is sufficient to open the mouth. This pressure may be insufficient to propel the projectile at a velocity sufficient to kill a person, though it may cause serious wounds. If a death, under such circumstances, is reported, it is probably fake. It demands a careful investigation.

3.4 Constructional Features

The constructional features of a projectile have a profound influence on its wounding power. The main determinants of the wounding effect of the projectile, in addition to its velocity, weight and diameter, are:—

1. **The constructional material.** Mild steel, copper, etc. are replacing the traditional material lead partly or fully.
2. **The shape of the projectile.** A pointed nose of the projectile, which, all the high velocity bullets possess, facilitates the proper penetration of the projectile.

   The streamlined bullet[1] shape is ideal for penetration of the target. The sharpness of the pointed nose of the bullet helps in greater penetration. However, the projectiles create two practical problems:

   a. It needs extreme care in its manufacture so that the centre of gravity coincides with the centre of the shape (form). If the two are separated even by .0025 cm, the projectile will strike about 25 cm away from the target, at a range of 600 metres.
   b. The streamlined bullets may pass through the body smoothly, without transferring energy and causing serious injuries. The penetration of the body though important, yet more important is its function to cause damage to the tissues. Streamlined bullets do not perform the latter. Consequently, they are not used in the manufacture of ammunition.

   Most of the projectiles, used in military ammunition are boat-tailed. These projectiles have excellent penetration and wounding powers. The boat tail also reduces the air drag.
3. **Terminal performance of the bullet.** The ideal bullet with optimum wounding effect enters the body in nose/near nose onward position, without getting deformed and fragmented. After entering, it transfers

1. See Section 3.12 of the Chapter 3, p.

its energy to inflict the injury. For proper performance, the projectile should be hard (inflexible) with sufficient sectional density. Modern bullets have heavy lead cores. A hard metal jacket (copper/its alloys or steel) covers the lead core. The lead core gives adequate sectional density to ensure proper ballistics. The copper or other hard material jacket prevents deformation and ensures proper penetration. Such a bullet may pass through the body without incapacitating the person if it does not damage a vital organ, and hence not very effective.

4. **Expanding bullets.** The modern bullets do not cause through and through injuries. They, on entering the body, expand, fragment or break into pieces. The tip of such bullet may be hollow/exposed/crosscut. The jacket-envelope may have different thickness at different places to ensure both adequate penetration and expansion. These projectiles, after penetration, cause serious wounds immediate shock and incapacitate the hit person.

   Such projectiles are not supposed to be used against human beings. However, criminals seldom bother about such niceties. The service ammunition of almost all the countries now has bullets, which deform or fragment inside the body. The USA service rifle bullets are notorious in this respect.

In a multi-murder case, one of the victims was hit with a soft point high velocity projectile. It hit the person on the back and created an exit hole on the front. The whole mass inside appeared to have been torn out. The exit hole was several centimetres in diameter. Only the jacket, stuck in the spine, was recovered. (CH)

Indian service rifle bullet (5.56 mm, INSAS) breaks on entry in the body because of soft nose. The fragmented bullet and dual steel and lead cores cause extensive tissue damage.

3.5 Range

The increasing range of fire, in addition to reducing the velocity of the projectile, influences the wounding effects in two other ways:—

1. The gases and the lighter particles of the ejecta are dispersed. They do not reach or enter the target.
2. The initial instability of the projectile goes away and the bullet does not wobble, except at extreme ranges.

The gases, smoke, semi-burnt or unburned powder residues, metallic particles, dirt and wads, if any, constitute the lighter ejecta. They are important in the wounding effects only in contact or near contact wounds. Under these conditions, the ejecta enter the body en masse. The expansion of the gases takes place inside the body. They cause **'Explosive Wounds'**. The wounds have the following characteristics:—

1. The destruction of tissues inside the body gives the appearance of an explosion. The damage may not appear so extensive outside.

2. There is no charring, blackening or tattooing on the outer margin of the injuries in most of the cases of contact wounds. They are found inside the wound.
3. The gases may come out of the entrance wound. The outgoing gases evert the margins. The injury may look like an exit wound. Sometimes, the damaged or undamaged organs (like the intestines) may protrude out from the entrance wound.
4. If the wound is at a place where the skin covers the bone, some gases may enter in between the skin and bone and tear the skin in a characteristic fashion, making the wound ragged or star-shaped. The bone, in addition to crater formation, is fractured.
5. The shot charge spreads inside, though there may be only one entrance hole. The spread is erratic and does not permit the estimation of the range.
6. The wads of a shotgun can inflict fatal injuries from a contact or near contact range.
7. The blast alone can cause fatal injuries, from close ranges.

The effect of the instability of the projectile on the nature of the wounds in the initial stages of its flight is immense. The projectile in the initial stages is wobbling. It, therefore, may not strike in the nose-onward position, as supposed. It may strike in side-onward position, producing what is known as a *'key hole'* wound. The key hole may also be obtained if the projectile ricochets or brushes against some light material. The instability of the projectile can be due to structural defects of the projectile or due to incompatibility of the bullet with the barrel bore, or some other reason (s).

The projectiles become unstable at the extreme ranges and wobble. The wounds caused by such bullets will also be abnormal, but such tumbling bullets may not cause fatal wounds, because of the reduced striking velocities, at the extreme ranges.

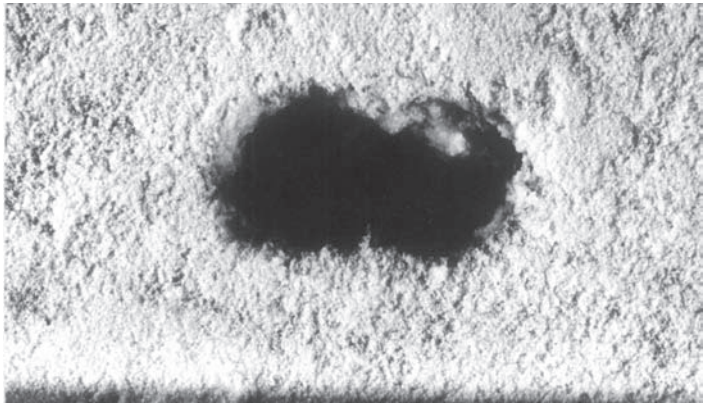

Fig. VII-15

The instability of the projectile may also be due to the deformation of the projectile. An experimental key hole formed by a .22 rifle projectile. The rifle repeatedly gave key hole formation. Examination of the bullet revealed elongation of the projectile inside the barrel.

4. BULLET RESISTANT BODY ARMOUR

Body armour has been in existence for a long time. Dhal, a curved piece of Rhino's hide, was perhaps the first armour, in India, in sword fighting or defence against arrows and spears. It gave way to steel armour, which covered the vital organs of the body and protected them from spears and arrows attacks. The steel armour was heavy. They did not provide adequate protection against firearm projectiles.

Research on synthetic fibre/fabrics has brought in projectile resistant jackets and vests. Their use has increased tremendously in recent years. Many persons, especially politicians, who fear firearm/knife attack, wear them.

High tenacity Aramid fibres, coated by polycarbonate layers, are used for the quality safety clothes. The ballistic panel is made of a multi-component materials designed and validated for achieving maximum protection while maintaining flexibility and lightweight of the vest and other garments.

Currently the nylon and polythene fibres are being used for lightweight body armours. Polythene fibres are the new favourites.

1. **Kevlar**. It is nylon-based material, used to manufacture protective garments.

Polythene fibres being used include:

a. **Gold flex (**Honeywell)
b. **Spectra** (Honeywell)
c. **UD Aramid Fabrics**
d. **Dyneema** (by DSM)

The garments from these fabrics deform the projectiles. They dissipates the kinetic energy of the projectile; thus, protecting the targeted person. Hard plate with or without the fabrics are also used.

SHOOTING INCIDENT SCENE

SYNOPSIS

1. GENERAL
2. IMPORTANCE
3. NATURE OF EVIDENCE
4. EVIDENCE MANAGEMENT
5. THE PROBLEMS
6. HANDLING THE SHOOTING SCENE
- 6.1 Preliminary Scene Management
- 6.2 The Evidence Handling
    1. Location
    2. Evidentiary Clues

7. DOCUMENTATION
- 7.1 Administrative Log
- 7.2 Preliminary Work Log
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- 7.4 Digital Photography
- 7.5 Crime Scene Sketches
- 7.6 Narrative Log
- 7.7 Evidence Log
- 7.8 Custody Log

8

SHOOTING INCIDENT SCENE[1]

"The success or failure of criminal investigation starts and ends at the crime scene".

Fig. VIII-1

A close-up of the evidence after the removal of the body. The outline of the body is marked with white powder.

1. For detailed crime scene handling, see chapter on ***Scene of Occurrence*** in the Author's book: ***Forensic Science in Criminal Investigation and Trials***. Publisher: LexisNexis, India.

1. GENERAL

The investigation of shooting scenes needs sound knowledge of firearms, ammunition, external (also called exterior) and terminal ballistics, the human anatomy and psychology. It is a tough task for an average IO. In most of the important cases, he requisitions forensic expert help.

Shooting is involved in serious crimes like murders, attempted murders, kidnappings, robberies, terroristic activities, political vendetta and the common causes the disputes over land, money and females. They often spell death or serious injuries to the victim. The successful investigation determines the real mettle and competence of the IO.

The courts dive deep into the evidence so that no innocent person is convicted, as the penalties of murders are ruthless: death or life imprisonment. acquitting judges take the Royal Road: the evidence presented did not prove the guilt beyond reasonable doubt. The verdict in most of such cases is acquittal.

The IO has, therefore, to do an extra mile to find evidence to prove the guilt of guilty beyond reasonable doubt.

2. IMPORTANCE

A shooting crime scene is the place where a crime committed involves use of firearms. It may also include places, which are connected with the crime (hidden dead body!).

The shooting crime scenes are varied. It may be indoor or outdoor. It may be a room, a cellar or a roof. It may be a road or a roadside, an open field, a jungle, hill or a mountain, a stream or a river. It may be a pond, a lake or seashore. It may be a desert or a deserted place. It may be a vehicle: a car, a truck, a bus, a train, a boat, a ship or an aeroplane. Every shooting crime scene presents unique aspects for which the examination technique may need some modification/variations.

As the criminal and the victim meet at the shooting crime scene, it is repository of physical evidence, which link the criminal with the victim and with the crime scene. The persons involved also pick up traces from the scene and object thereon. In addition, they may leave miscellaneous items and marks of all sorts: fingerprints, footprints, tyre marks, tool marks, marks of wearing apparels, etc.

Disturbance at the scene indicates the pattern of events. Thus, the shooting crime scene provides materials and other clues, which help investigations to:

1. Establish *corpus delicti.*
2. Link the criminal, the victim and the scene *inter se.*
3. Help to appraise the pattern/sequence of events.
4. Indicate *modus operandi.*
5. Help reconstruction of the incident.
6. Identify criminals/victims.

7. Determine the number/nature of the firearms.
8. Know the transport used.
9. Ascertain the routes of ingress and egress.

The shooting scene changes rapidly. Some of the evidence gets lost soon. Some evidence is contaminated or altered with time. If shooting crime scene is a public place, it has to be opened to the public at the earliest. Therefore, the scene needs immediate processing.

You get only one opportunity to examine the crime scene. If it is lost, the evidential plethora is lost forever.

3. NATURE OF EVIDENCE

A shooting crime scene is a rich source of evidentiary clues including the following:

1. Firearm and/or its parts, its holster, magazines with/without ammunition in/out of the firearm.
2. Fired ammunition: fired projectiles, fired cartridge cases, wads, GSR. They may be present in the body/on the person of the victim/at the scene lying around/embedded in the walls/floor/furniture/beddings or entangled in the victim's clothing, etc. They may be or whole/ damaged/fragmented/broken into parts.
3. Improvised firearms.
4. Projectile marks/holes at the scene or on articles at the scene.
5. Shattered/pierced glass.
6. Projectile marks and injuries on the person of the victim. They provide a lot of information including:
   a. The number of shot fired on the victim.
   b. The direction of fire.
   c. The range of fire.
   d. The nature of the firearms.
7. Circumstantial evidence.
8. Miscellaneous pieces of evidence common to most of the crime Scene:
   a. **Prints/Impressions**: foot and footwear marks, fingerprints, tool marks, fabric impressions, tyre marks, and bite marks
   b. **Trace evidence**: Hair, nail scrapings, fibres, paint, arson related initiators/accelerators/fire promoters, GSR, glass
   c. **Stains:** blood/blood stains patterns, body fluids stains,
   d. **Documents**: singed/burnt/torn/shredded/disputed:

4. EVIDENCE[1] MANAGEMENT

The varied pieces of evidence found at the scene, in shooting cases, are managed variedly. Forensic Scientist provides comprehensive forensic assistance at the crime scene. Some additional specialists are also needed for specific type of evidence. In shooting cases (and in other cases) fingerprint, medico-legal and firearm expert are often indispensable.

1. **Fingerprint experts** help to locate/develop/collect/evaluate the evidence.

2. The IO usually collects the body materials for DNA analysis, which is carried out by a DNA analyst. However, he can always requisition the help of forensic scientist.

3. Firearm/ballistics experts have a lot to do:
   a. Locate/help collect/examine the fired bullets/cartridge cases and furnish some guidelines as to the number/nature/calibre of the firearms used in the case under investigation.
   b. Study/identify projectile marks/holes at the scene[2]. They help to find the trajectory of the projectile. The trajectory helps to fix the position of the shooter and the direction of fire.
   c. Evaluate GSR patterns on the victim's clothing/skin or on the objects at the scene help to determine the range of fire.
   d. Examine the hands of the suspect/victim for gunshot residues (GSR) to identify/eliminate the suspect/victim as shooter.

5. THE PROBLEMS

Proper examination of the shooting crime scene helps to answer the following questions:

1. Is the alleged shooting scene genuine or simulated?
2. How did the criminal/victim reach/leave the scene?
3. Where are the entrance/exit wounds/sites?
4. How many criminals/firearms/victims were involved?
5. What were types of firearms used in the shooting?
6. Did both the parties use firearms?
7. How many shots were fired?
8. What was the range of fire?
9. What was the direction of fire?
10. When was the crime committed?
11. Who were the criminals or victims?
12. Were the fugitive criminals injured? How seriously?

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1. Kindly see chapter 9 *'Evidentiary Clues'*.
2. Dithiooxamide/sodium rhodizonate are chemicals for tests.

6. HANDLING THE SHOOTING SCENE

Fig. VIII-2

Still photograph identify the scene.

Fig. VIII-3

The tattoo photographed identifies the victim later.

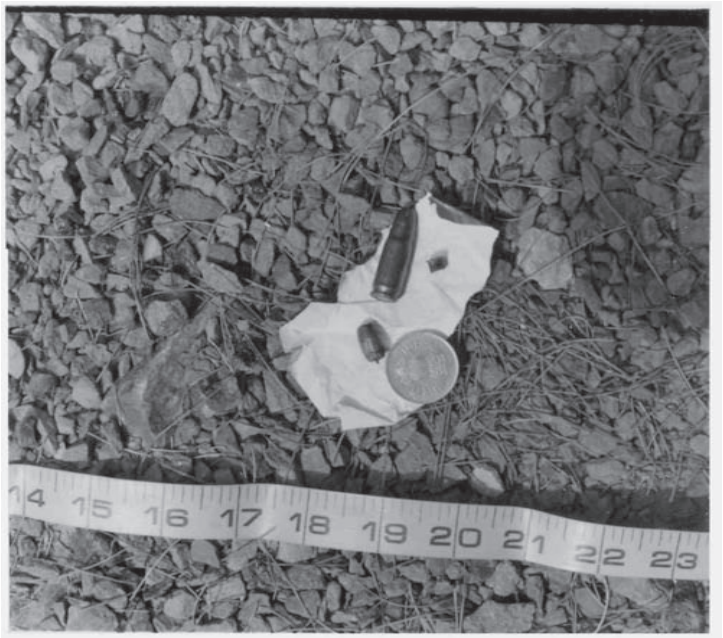

Fig. VIII-4 ***Fig. VIII-5***

The clues in the photographs provide the where withals to ultimately link the culprit with the murder. The clues were first (before collection) photographed at the sites where they were found (not shown)

The handling of the shooting scene work is usually three-part process:

1. Preliminary scene management.
2. Evidence management.
3. Documentation of the scene/evidence.

6.1 Preliminary Scene Management

Preliminary scene management, in shooting cases, is the work of the first police officer who reaches the shooting scene post-haste to safeguard and preserve the scene. He does not investigate or interrogate. He simply protects and preserves the scene and identifies, controls and keeps the culprits, the suspects, their sympathizers and the witnesses who may be present at the scene segregated. The summary of his work at the scene is:

1. He checks the injured for any signs of life. Even when there is a remote chance of the victim being alive, provides medical help immediately and arranges to send the victim to the nearest hospital.
2. He takes the above steps with deliberation and caution, ensuring minimum disturbance to the scene. If the injured is already dead, the scene is left undisturbed.
3. He excludes all the unauthorized men: relatives and friends of the victim or of the culprit, onlookers, photographers, media correspondents and others from the scene. He handles them politely, persuasively, yet firmly.
4. He barricades the crime scene, covering a larger area than the obvious scene.
5. He requisitions the help of chawkidars, home guards or of other similar organisation to protect the scene and for messenger duties, if required.
6. He prevents suspects and witnesses from discussing the case *inter se*.
7. He arrests the positively identified culprit (s) and detains the suspects. If they try to run away, he arrests them.
8. He prevents fellow officials (including senior officers) from entering the scene to satisfy their curiosity.
9. He instructs assisting officer(s) to do his biddings only, no investigations!
10. He assesses the additional help required. It may be additional force, photographers, draftsmen, Forensic/medico-legal experts, and others.
11. He apprises the superior officers about the crime, the criminal and important details.
12. He does not leave the scene until the IO arrives and takes charge of the scene.
13. He records the name of the informant, his address and the time when he gave the information, brief details of the incident. He detains the informant for additional information in important cases.

14. He does not discuss the case with the suspects/complainants/victims/witnesses/onlookers/pressmen.
15. He keeps his ears and eyes open/listens to casual remarks/observes the behaviour of the persons around.
16. He does not deposit his fingerprints/foot/footwear marks/cigarette stubs/cigarette ash, etc. on the scene.
17. He preserves the doors/windows/staircases/lighting/routes of ingress/egress in their original condition until the IO takes over shooting scene.
18. He records the time of arrival/the weather conditions/the odour at the scene, if any. Alcohol, petrol, tobacco, perfumes, kerosene oil and explosives leave distinct odours.
19. He does not change original position/condition of anything at the scene. The motto is:

    "AS IS AS IT WAS"

20. He does not use the utilities of the shooting scene (bathrooms, washbasin, lavatories, towels, telephone, etc.).
21. He does not clean the crime scene, even if it is in a mess.

Note: Alteration of positions of objects is done only in emergencies only. They are record.

6.2 The Evidence Handling

The IO [or the special investigating team (SIT)] handles the evidentiary clues at the scene. He locates, collects, preserves, packs, seals and despatch the evidence systematically. He ensures continuity of the chain of possession of the evidence.

The IO takes the following steps:

(1) He walks through the scene to get a bird's eye view of the evidence and its disposition at the scene.

(2) He ascertains whether the scene is genuine or fake. He often takes the experts help to ascertain the same.

(3) He documents the scene through videography/photography/sketches/textual description.

(4) He establishes entrance/exit routes.

(5) He collects all foreign materials (to the place), whether they appear relevant or irrelevant to the case, at the time of collection.

(6) He first collects microscopic evidence (hair, dust, fibres, paint, etc.); then prints and impressions, stains, etc. and then the gross objects. He ensures safety/purity/authenticity/integrity of the evidence and maintains its chain of custody unbroken.

(7) He ensures that he does not introduce his fingerprints on the objects handled:

    (1) Handles flat objects from edges.

(2) Handles bottles/tumblers and the like from the rims or other area unlikely to carry fingerprints.

(3) Handles firearms, knife, dagger, etc. from the edges or such places where fingerprints are not likely to exist.

(4) He lifts small objects with forceps.

(8) He dries the stains before packing. Bacterial growth and other changes destroy or contaminate the wet stains (or articles) when sent in wet condition.

(9) He uses for packing:

(1) Clean/sturdy receptacles.

(2) Non-corrodible containers to packs corrosives.

(3) Seepage/penetration proof containers/packing materials: appropriate plastic/glass/cardboard containers with proper lids or stoppers to prevent evaporation or spilling.

(10) He packs the exhibits in such a way that they do not explode/ignite/get damaged in transit or on opening.

(11) He packs only one item in one packet.

(1) He prevents rattling, rubbing or scraping of the articles in transit; otherwise, valuable evidence, contaminated or lost. He sends dangerous articles and exhibits likely to be damaged in transit, through a special messenger.

(2) He marks the evidence distinctively and put his initials with date, if possible. He does not damage the articles recovered or the evidence thereon, in the process. For example, he does not mark the projectiles/fired cartridge cases at places where they carry barrel marks.

(3) He seizes, packs, seals the evidence in the presence of two reliable witnesses, and obtains their signatures on the cover.

(4) He places 3 specimen seals impressions, clear and legible, on the case file and also sends another set of specimens to the expert, along with the covering letter.

If necessary, he dispatches a number of packets (properly marked) in one box along with a description chart of the contents of the various packets in the box.

(12) He packs exhibits of different cases in different boxes.

In a case, exhibits were sent duly sealed to the expert along with a specimen seal of the magistrate with whose seals they were sealed. The expert certified that the seals were intact. When the magistrate, a witness in the sessions trial, examined the seals, he found them different from his own seal. **(CH)**

In another case, a bullet was sealed in a bottle. The cap (screw type) of the bottle could be unscrewed along with the patch of cloth, which had the seal on it, without breaking the seal. **(CH)**

In another case, a parcel bore six seals with the same monosyllables. When critically examined, they were found to originate from two sources. The defence alleged tampering of the evidence and got acquittal. **(CH)**

(1) He describes the contents.

(2) He inscribe/attaches identification data (FIR No. with date, name of, PS, etc.) to the evidence properly.

In a case of murder, 12 bore fired cartridge cases were stored in a damp place. When they were put up in the court (along with a score of others cartridge cases), the correct cartridges could not be identified in the court. Fungus growth and incrustation had damaged the paper tubes so much that the identification marks put on them were destroyed. **(CH)**

In another murder case, the exhibits, a gun and a cartridge case, returned from the laboratory, were exhibited on the first day. However, when the experts appeared on the second day, the cartridge case was missing. Presumably, it had, been stolen from the court. **(CH)**

13. He lets minimum persons handle the exhibits. The ideal sequence is:

    IO ⟶ Expert ⟶ Court

    It is often not possible.
14. He dispatches the exhibits to the concerned experts promptly, through a special messenger. Otherwise, the defence alleges tampering of the exhibits. The courts dismiss quite a few cases because the investigating officers do not despatch the exhibits promptly to the expert and cannot account for the delay.
15. He records/documents everything done at the scene.

1. Location

The shooting crime scene is identified/located from:

1. Presence of *Corpus delicti.*
2. Marks of projectiles/GSR.
3. Presence of fired cartridge.
4. Characteristic damage to objects at the scene.
5. Accounts of eye-witnesses.
6. Left over arms/fired or unfired ammunition.
7. Projectile traces at the objects at the shooting scene.

It is not difficult to locate the shooting scenes, but sometimes criminals simulate/fake crime scene to mislead the investigators, to avoid suspicion and try to pass on the guilt to others. Sometimes, natural phenomena may change the scene of occurrence. The body may be carried away by water currents or fish in water; or, by carnivorous beasts in jungles and in other open spaces.

2. Evidentiary Clues

Evidentiary clues are at the scene/on the victim/with the culprit or at places used to hide/destroy the evidence. The IO collects them, preserves them,

seals them and dispatches them to the concerned quarters, usually to the State Forensic Laboratory. The details of processes used in handling the evidence at the shooting scene are in chapter nine (9) of this book.

7. DOCUMENTATION

Proper documentation of the scene and of the evidence thereon is imperative. The courts do not accept the evidence, in which the inter-linkage of the scene, the culprit, the evidence, the firearm, etc. is not established through proper documentation.

It is unfortunate that we, in India, do not give needed importance to documentation of the crime scene and the evidentiary clues thereon. Consequently, many a court case ends in acquittal. The fact came to the notice of the author in a very dramatic way.

The author after giving evidence in a murder trial in a sessions trial was having an informal talk with the judge when the judge casually remarked:

"Dr. Sharma, I have yet to utilize your evidence in the dissemination of justice."

The author was stunned. He might have given evidence before the same judge in more than a dozen cases! All gone down the drain!

The author could not help asking the judge:

"Sir, what was wrong with my evidence?"

"No. No. there was nothing wrong with your evidence", the judge replied. "But the recovery of the evidentiary clues on which your evidence was based was not documented properly, beyond reasonable doubt. "He recited an Urdu couplet:

***"Raig par tahmir-e-makan koi kaise kare?"[1]* (CH)**

The need for proper documentation could not be brought forth more forcefully to the author.

The documentation in the handling of the shooting (and other) scene has the following components:

1. Administrative log.
2. Preliminary survey log.
3. Videographic (videotaping) log.
4. Photographic log.
5. Sketch log.
6. Narrative log.
7. Evidence log.
8. Custody log.

7.1 Administrative Log

Administrative log is a record of the basic information about the crime, the investigators and the controlling officers. Usually, the IO records the information in a proforma. It contains the following information:

1. How can one build a house on sand?

a. Name of the informant, with address.
b. FIR No. with date.
c. Police station; district.
d. The legal authority/law under which the investigation is being done.
e. The informant who informed about the incident.
f. The crime scene address.
g. Contact source at the scene, if any.
h. The departure/arrival of the first officer (name, rank) to the scene: time/date/mode are recorded.
i. Chief of the Special Investigation Team (SIT) is specified.
j. Names of the members of SIT:
   (1) Photographer.
   (2) Imaging Expert (name).
   (3) Ballistics expert (name).
   (4) Medico-legal expert (name).
   (5) Police officials (names).
   (6) Any other specialist.
k. Time Element:
   (1) Time of occurrence.
   (2) Time of receipt of information.
   (3) Time and date of departure of SIT for the scene.
   (4) Time and date of arrival of SIT at the scene.
l. Weather and other conditions at the scene.
m. Changes, if any, in the composition of the team, recorded chronologically.

7.2 Preliminary Work Log

The first police officer who reaches the scene first, carries out the preliminary work discussed above. In case the SIT is the first to arrive at the scene, the leader of the team performs his functions.

Every scene has some peculiarities. The preliminary survey makes it possible to plan the handling of the scene effectively and efficiently.

7.3 Videographic (Videotape) Log

Videographic coverage of the scene of occurrence has assumed great importance in recent times. It is the first action the police take after attending to the needs of the injured. A videotape of the scene is indispensable:

(1) A video record of the scene preserves the scene in its original state as provides vivid picture of its structure/the relationship of the evidence thereon. It helps to reconstruct the nature of occurrence: Murder/ suicide/accident etc.

(2) A videotape brings the scene of occurrence to the courtroom. The case comes to the court after a long time, sometimes, after years. The court even if it wants to see the scene at that point of time, is unable to do so. The passage of time changes the scene structure. A videotape of the scene, taken soon after the occurrence, in pristine form, can vividly portray the scene to the concerned (the judge, the counsel and others) and reveal the reality at the scene effectively. The police are using videotaping of the scene increasingly.

(3) A videotape permits the investigators to **'revisit'** the scene and check the new hypothesis about the *modus operandi* of the occurrence from the evidence at the scene.

(4) A videotape of the scene helps the ballistics expert to reconstruct the occurrence, even after months or years, to decide if the shooting was a case of murder, suicide or accident, etc.

(5) The tape covers the total evidence in one go on one format.

Videotaping has other advantages. It is cheap, it is available everywhere, it does not need studio processing, it is instantaneous; the results of the coverage can be verified there and then, If there is need for a retake of the scene, it is easily done. The scene is thus, made 'live' forever.

The following tips are helpful in crime scene videotaping:

(1) Use a professional camera, which should be shake-free, have title-writing and automatic date and time recording facilities. The facility thus, can record the crime data/title-writing on the video-film.

(2) Use normal lens for the general scene, wide angle for the indoor scenes and close-up and macro lens to highlight the important pieces of evidence.

(3) Fix the scene site. Videotape the general location of the scene, the position of -the building (*vis-a-vis* other buildings at the scene), the floor of the building and the room(s) involved in the scene with respects to other rooms of the building.

(4) Start videography from the point of ingress and trail the movement of the culprit to the point of egress, whenever they can be visualized.

(5) Move the camera very slowly while carrying out videotaping so that the scene recording is proper and no aspect of the scene is missed. Record the important areas a second time also.

(6) Reduce the movement speed of the camera further when covering the areas bearing evidence.

(7) Expel the onlookers from the scene so that they are not videographed in the tape. Likewise, the investigators should not be included in the scene video.

(8) Record the scene in noise-free atmosphere, whenever possible, to prevent induction of unconnected sound/noise in the video.

(9) Make the video-film of the scene in its pristine condition, when it is least disturbed, immediately after the walk through/preliminary survey.

(10) Complete the recording of the scene in one go.

(11) Use new tape. It should contain only the recording of the case in hand and no other recording.

Once the video recording has been completed (and scrutinised), a master tape is prepared from the same which is preserved in safe custody. Copies of the tape are prepared and supplied to the concerned.

7.4 Digital Photography

An old adage:
"One photograph is better than a 1000-word description"

In spite of the documentation of the scene by videotaping, still photographs are still essential to document the scene. Not only they reduce the narrative description but they also provide easy assimilation and trustworthy evidence of the scene. The following tips relating to shooting scene documentation are helpful:

(1) Plan the photographic coverage.

(2) Use professional DSLR camera with the needed accessories. A 35 mm format camera with telephoto, normal, wide angle, close-up or macro lens and non-fixed flash light, tripod, should be adequate to photograph the evidence in most of the situations. Some evidence may need the use of more than one type of lens to cover the evidence properly.

(3) Place a scale and chit (carrying case data) near the evidence being photographed.

(4) Keep proper log of the photographs taken. There should be no confusion about the place and items, *vis-à-vis* the photographs taken.

(5) Cover the following:

a. The location of the crime scene *vis-a-vis* its surroundings

b. The identity and placements of the building, floor, room(s), etc. where the crime was committed in respect of their surroundings.

c. The routes of ingress and egress of the culprits

d. The position of the *corpus delicti vis-a-vis* other items at the scene

e. The identity of the victim(s), through a close-up photograph of the face(s); take two photographs of the identity of each victim, as a matter of routine.

f. The disturbance due to struggle, if any, at the scene

g. Each piece of evidence: firearm, cartridge case(s), projectiles, wounds, holes, GSR, marks, etc. It is preferable to take two snaps of each piece of evidence.

h. Minutiae, GSR and the like. Close-up photographs!

i. The spatial layout of the various items on the scene, to fix the position of the various evidentiary clues *inter se*, for easy visualization, even after long intervals.

j. Every item that has even the least chance to be a piece of evidence. It is better to be more generous in taking photographs.

k. Large areas with aerial photography, if necessary

(6) Follow videotape sequence for still photographs.

(7) Collect copy of its footage of CCTV coverage of the scene, whenever it is there.

(8) Take two photographs of each piece of evidentiary clues, one with a scale and one without one.

(9) Record the nature and the purpose of the evidence photographed.

(10) Collect copies of the images of the scene taken by the media/onlookers/neighbours/family have photographed the same. There may have been lesser disturbance.

Digital photography has made tremendous strides in recent years. It has almost completely pushed out film photography. The versatility of digital photography cost effectiveness, elimination of photo studio work, better control of the picture selection, immediate verification of the results and replacements of defective images, practically unlimited picture capacity, etc. make digital photography an ideal mode to take images of the shooting (and other crime) scenes.

Fig. VIII-6

The photograph indicates the location of the body.
The inclusion of the wall (at the top) fixes the location of the scene.

Fig.VIII-7

A close-up of the face permits a proper identification.

Fig. VIII-8

A close-up of the evidence.

7.5 Crime Scene Sketches

To a nonprofessional it may look strange that after all the videotaping and digital photography of the shooting scene the investigators need sketch the scene. However, Sketches play an essential role. A proper sketch of crime scene, drawn to scale, is superior to a photograph in some respects:

a. A sketch is bereft of irrelevant articles (present at the scene) and has only relevant items. The viewer appreciates/assimilates the dispositions of the evidentiary clues in one glance.
b. The sketch indicates the directions/inter-distances/positions of the clues *inter se*. The onlooker can understand the inter-relationship of the evidence at one glance.

c. Photographs are usually two-dimensional. Three-dimensional sketches are coming up. They depict the evidence in a better way.

Ordinarily, the investigator selects the type of sketch he would like to draw. The sketch has to cover the important evidence. He makes a rough sketch of the perimeter, fills in the evidence he wants to show in the sketch, records inter-distances and indicates North ('N') on the sketch itself through an arrow head sign (↑). In addition, he writes the following details on the sketch:

a. Crime scene address.
b. Case reference: FIR No., date, PS, etc.).
c. Date (and time) of preparing the sketch.
d. Legend.
e. Signature of the IO/person who sketched the scene.

It is now common practice to get an additional sketch drawn to scale by a professional: draftsman/revenue official (Patwari). The IO provides the data (the rough sketch!). Now, more importantly, 2- and 3- dimensional sketches are being created through computers based on collected data.

The final sketch has the following elements:

a. North shown by an (↑) shows the directional layout of the scene.
b. The scale, to which the sketch is drawn, is given.
c. The evidentiary clues are placed at the correct sites in the sketch.
d. A legend details the inserts on the sketch.

The original rough sketch is preserved until the final disposal of the case.

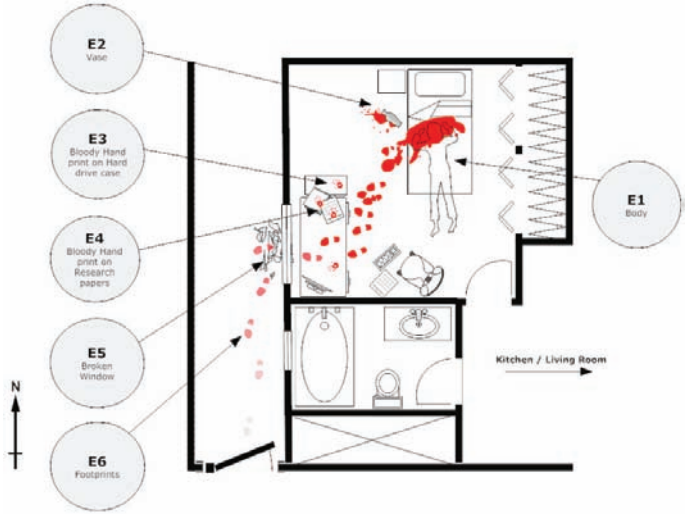

Fig. VIII-9

'Smartdraw'[1] electronic software graphics. A typical 3-D sketch

1. Proprietary name of the software.

7.6 Narrative Log

The narrative log is the record of the general observations of the crime scene and the work done by the SIT/IO at the scene. Formerly, the record was in the written form. Now the narration can be oral, recorded in a tape/CD/cassette. The narration mode has yet to find currency in India.

The narrative report has the following features:

(1) The report should be factual:
   a. No views
   b. No appraisal
   c. No reviews

(2) The report is on the departmental report format, if there is one.

(3) The nature, condition and the extent of the shooting incident.

(4) The identity, position and the condition of the victim as found on the scene. If he is still live. If dead, the position and the condition of the body and the surroundings are recorded.

(5) Signs of any activity (drinking, eating, playing cards, etc.) prior to the shooting are located/recorded.

(6) The nature of the crime (robbery, sexual assault, drug abuse or sale or purchase of narcotics) is ascertained.

(7) The *modus operandi* if evident is recorded; no guess work.

(8) Any abnormality or characteristic feature of the shooting scene is noted.

(9) The obvious evidentiary clues may be to mislead, their fake or genuine nature is ascertained.

(10) The name(s) of the culprit(s), if identified, or caught by the public are noted.

(11) The names of the eyewitnesses, if any, are noted with their addresses/ phone numbers.

(12) The report gives briefly the action taken on:
   a. Protection of the scene.
   b. Video-filming of the scene.
   c. The photography of the scene.
   d. Location, collection, packing, sealing and dispatch of the evidentiary clues found at the scene.

7.7 Evidence Log

Evidence log contain information about the evidentiary clues. Their location, collection, packing, etc., to ensure their identity, integrity and relevancy, is described. The document is important. It provides answer to the following questions:

1. What is the nature of the evidentiary clue collected?

2. How much is the quantity on the material?
3. Who located, collected, packed and sealed it?
4. Where was it found?
5. What was its condition at the time of its collection or seizure?
6. Who witnessed its collection or seizure?
7. How was it preserved?

The information on all the above aspect and any other aspect is recorded on a proforma, usually prescribed by the department. A simple type of proforma is given below:

EVIDENCE PROFORMA

A. General:

a. FIR with date, PS name, and location of the shooting scene
b. Evidence Chart

CHART

No.	Clue	Site	Condition	Quantity	Container	Witnesses	Remark

Signature of IO

7.8 Custody Log

Custody log is also known as the **chain of possession log,** contains the record of the movement/custody of the evidentiary clues, from the time of its collection to the time it is submitted to the court. The log has the information:

a. Who located/processed the evidence?
b. Who witnessed the seizure of the evidence?
c. Who deposited the evidence in the *malkhana?*
d. Who received/kept the evidence in *Malkhana?*
e. When/who took the evidence from the *malkhana?*
f. Whom was it delivered in Forensic Science Laboratory?
g. Who brought back the evidence to *malkhana?*
h. Who produced the evidence in the court?

The custody log thus, indicates where and in whose possession the evidentiary clue was at a particular time/date. It ensures that the clue is not switched/ tampered. There should be no time gap in the possession of the exhibits. The continuity of chain of possession of evidence is sacrosanct to make it acceptable to the court.

All, except the IO and the expert handle the evidence in sealed condition.

IO at Shooting Scene (nutshell)

1. Frames investigative strategy.
2. Provides medical assistance to the injured.
3. Ensures safety of the investigating team.
4. Preserves, protects, documents/records (videography, photography, sketching, textual notes) the scene.
5. Detains suspects, arrests culprits, segregates witnesses, collects intelligence about absconder(s).
6. Locates, collects, preserves, pack, seal and despatch the physical evidence present at the crime scene/with the culprit/victim/vehicle/weapon/intelligence people.
7. Attends postmortem examination, to get comprehensive medical data about the deceased and the complete injury profile.
8. Utilises all the resources at his disposal (and more) in investigation
9. Keeps the seniors informed about the progress.
10. Releases the scene only after he has finished with it.
11. Follows the law and the departmental rules.
12. Records the basic data:—
    a. His Arrival time at the scene.
    b. The weather conditions at the scene.
    c. The state of doors/windows/ventilators/bathrooms/taps, etc.
    d. Any oddities at the scene, characteristic odour, etc.?
13. Records the action taken at the scene.

ADDITIONAL READING

US, National Institute of Justice. *A Guide to Death Scene Investigation.* [https://www.nij.gov/topics/law-enforcement/investigations/crime-scene/guides/death-investigation/pages/welcome.aspx]

EVIDENTIARY CLUES

SYNOPSIS

1. **GENERAL**
2. **LOCATION**
   - 2.1 Scene of Occurrence
   - 2.2 Firearm
   - 2.3 Fired cartridges
   - 2.4 The projectiles
   - 2.5 Wads
   - 2.6 Victim
   - 2.7 Culprit
   - 2.8 Live Ammunition
3. **COLLECTION**
   - 3.1 Firearm
   - 3.2 Cartridge Case
   - 3.3 Projectiles
   - 3.4 Slugs and Shots
   - 3.5 Clothes
   - 3.6 Live Ammunition
   - 3.7 Glass Fragments
   - 3.8 Gun Shot Residues (GSR)
   - 3.9 Injuries
   - 3.10 Projectile Marks and Holes
   - 3.11 Test Exhibits
4. **PROBLEMS**
   - 4.1 Firearm
   - 4.2 Fired Ammunition
   - 4.3 Medico-legal Problems
   - 4.4 Muzzle-loaders
   - 4.5 Live Ammunition
5. **ACCEPTABILITY**
   - 5.1 Identity
   - 5.2 Purity
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6. **EVIDENCE PROFORMAS**
   - 6.1 Evidence Information proforma
   - 6.2 Evidence Collection Proforma
   - 6.3 Forwarding Letter
   - 6.4 Laboratory Work Proforma
   - 6.5 Report Proforma

Annexure I.—Evidence Information Chart

9

EVIDENTIARY CLUES

1. GENERAL

The evidentiary clues available in shooting cases vary in nature. If they are properly located, collected and evaluated, they often link the criminal, the crime, the victim, the firearm and the scene *inter se*. The clues are helpful in establishing the sequence of events and in verifying a given version. They indicate the *modus operandi.* They help to find out if the shooting is accidental, suicidal, homicidal or in self-defence.

2. LOCATION

The important sources of the evidentiary clues are:

1. The scene of occurrence.
2. The victim.
3. The culprit.
4. The firearm and the ammunition (fired/unfired) may carry traces which sometimes offer decisive evidence.
5. The vehicles used in the commission of crimes often carry evidentiary clues.

2.1 Scene of Occurrence

The scene of occurrence is an important source of evidentiary clues. It indicates their number and their routes of ingress and egress. There are clues on the crime scene. They help to establish the crime scene is real or fake.

It is said that the success or failure of the investigations begins and ends at the crime scene. The IO, therefore, plans the handling of the scene to extract the maximum total evidence to link the criminal(s) with the crime, the victim and the scene, beyond 'reasonable doubt'.

While examining the scene of occurrence, the IO carries out the activities mentioned in the box below:

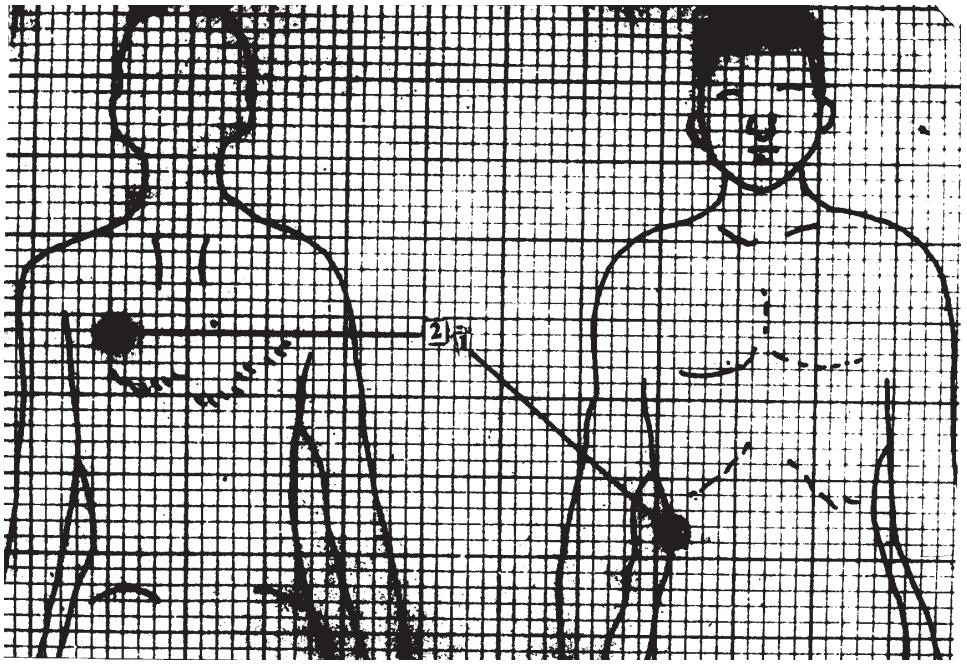


Fig. IX-1

Was it accident or murder? It had to be decided from the post-mortem report. In the present case there was only one injury - wound of entrance (1). Most of the charge of a 12 bore cartridge was found at position (2), almost under the skin. The angle of fire was almost 75°. Steep upward direction of fire ruled out murder under normal circumstances.

The scene of occurrence changes rapidly, therefore, its handling brooks no delay. Protection of the scene from the interested parties, curiosity hunters, traffic and natural elements is the first obvious step. The first police officer takes the step.[1]

The clues available at the scene are varied.

2.2 Firearm

In suicide and accident cases, the firearm should be at the scene. The position of the firearm *vis-à-vis* the deceased is important. Often the firearm is quite close in suicide or self-created accidental shooting cases. In some suicide cases, when the person has made elaborate arrangements to fire the firearm from a distance, the firearm is at some distance. Likewise, if the accidental shooting death is due to the mistake/failure of another person, the firearm may be at a distant place.

The firearm remains in the hand of the victim, if he suffered from cadaveric spasm at the time he committed suicide. In cadaveric spasm, the body or the part of the body stiffens at once as if it is in rigor mortis. The victim experiences cadaveric spasm only when he suffers from extreme mental or emotional tension at the time of death – often it is fright!

In a case of alleged suicide, the firearm involved was a revolver being held by the deceased in one hand. It could not be established whether the victim suffered

1. *See* Chapter 8: Scene of Occurrence.

from cadaveric spasm or not. However, when the chambers of the revolver were examined, a live cartridge was discovered at 12 O'clock position (instead of a fired cartridge). It indicated homicide rather than suicide.

Ordinarily, a person cannot hold on to the firearm after the death. **$(CH)_1$**

2.3 Fired cartridges

The semi-automatic and the automatic firearms eject the fired shells automatically after each fire. They are found at the scene.

If the culprit reloads a non-automatic firearm after firing at the scene, he is likely to leave fired cartridges at the scene. Theoretically, the culprit should take away cartridge cases from the scene. It does not happen in practice. The emotional disturbance and the urge to escape from the scene at the earliest, usually, prevent the culprit to collect and carry away the fired cartridge cases.

The automatic and semi-automatic firearms throw cartridge cases in a definite direction to a certain distance, depending upon the firearm. From the position of the fired shells, it is possible to fix the firing position of the culprit.

In a case of murder, the victim was killed at about 10 p.m. with a semi-automatic pistol. The killing was well planned. While the companions of the victim were taking the injured to hospital, the culprit visited the scene, picked up the cartridge case and vanished. The victim died in the hospital. The police searched the scene next morning for the cartridge case next day, but found none.

When they caught up with the criminal after about ten days, they recovered a weapon; fired one cartridge and showed the recovery of the cartridge from the scene on the day next to the day of murder. However, they made two mistakes:

1. *The cartridge case was shown to be at a distance of about 12 feet. The doctor and the ballistics expert showed it was a close range shot.*
2. *The bullet (jacket part recovered from the dead) and the fired case did not form parts of the same cartridge.*

The cartridge was made by Indian Ordnance Factory. It never manufactured a cartridge which had similar bullet jacket to the one recovered from the deceased. Obviously the police tried to pad the evidence but with disastrous result! The expert had not found any evidence to link or delink the jacket with the pistol recovered from the suspect. **$(CH)_2$**

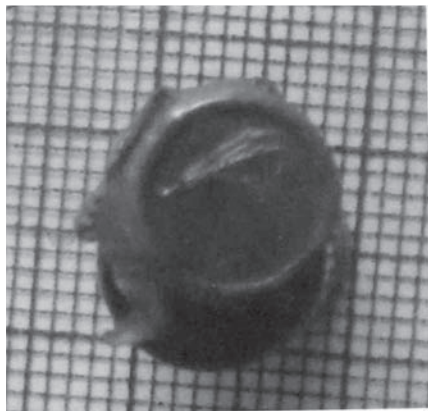


Fig. IX-2

The fired cartridges, found at the scene of occurrence, may carry fingerprints. They alone can connect the criminal to the crime.

2.4 The projectiles

They are usually found in the body of the victim especially when a handgun is the firearm used. They may also be found embedded in the walls, ceiling, doors, furniture, trees or ground at the scene. The scene is examined carefully and the projectiles recovered. The positions of the projectiles help in the reconstruction of the occurrence. Whenever possible, the article in which the projectile is embedded is X-rayed to find out the exact position/direction of the projectile.

> *In a police encounter case, it was alleged that the victims were shot after tying them to a tree. The stump of the tree was cut, shredded and examined. No bullets, their fragments or even their marks could be discovered on the stump of the tree. The version of the complainant was, apparently false. (CH)*

When a shotgun is used, the wads and their fragments fall at the scene, if not found inside the body of the victim. Their positions establish the direction of firing and the position of the culprit.

Bullet dents and ricochet marks on the doors, windows, walls, floor and the furniture help to reconstruct the occurrence.

2.5 Wads

Wads are found scattered in shotgun fire when the range of fire is more than two meters. If the range of fire is less they may enter the target, may stick around the target or fall near the target. Their scattering patterns indicate:

(1) The position of the shooter.
(2) The range of fire.
(3) The bore size of the firearm.
(4) The maker of the ammunition.

In most cases, most of the wads are shattered except the cushion wad. The pieces are found near the shooter. The cushion wad however can travel far, sometimes to a score or more metres.

2.6 Victim

The body of the victim may carry injuries, the projectiles: bullets, slugs, pellets, wads or their fragments, GSR (Gun-shot Residue) particles and holes and marks on the clothes[1] and on the skin. The projectiles create the holes, the marks and the injuries. Hot gases, discharge residues and the muzzle marks of the firearm provide vital information about the various aspects of the shooting incident.

The medico-legal experts locate/observe/evaluate and describe the firearm injuries. The small calibre projectile injuries of low and medium velocities are clean small entry wounds, sometimes difficult to locate. They often do not form exit wounds. The use of radiography is, therefore, crucial to locate them.

1. The clothes of the victim may also, carry blood, flesh, dust, fibres and hair from the culprit or from the scene of occurrence in a scuffle.

The medico-legal experts examine, evaluate and describe the injuries comprehensively. The description gives the nature, the dimensions and the number of the injuries, the path and the direction taken by the projectiles and the damage they caused. They distinguish the entry wounds from the exit wounds by describing their characteristics, eversion or inversion of the edges, charring, tattooing, blackening or deposits, if any, dirt or contusion rings, etc. They fix the number of entry wound. The information is essential to reconstruct the crime. If the projectiles (or their fragments) or the wads are still lodged in the body, their location is indicated. Radiography is used invariably to locate them. Radiography also facilitates the extraction of the projectiles or their fragments. Explosive wounds indicate the use of high velocity ammunition.

Whenever there is through and through injury in the body, the expert connect the entry wound and the exit wound and describes them. He must also describe the internal damage. In addition, he must photographs of the injuries and sketch of the internal path of the injury. Videography is being used increasingly to record the injuries and the damage.

The GSR deposit, on a target (victim) takes place in close range firing. A muzzle impression on the body of the victim is imprinted in a contact shot especially when the muzzle of the firearm is pressed against the victim's body.

The medico-legal expert records the close range phenomena both textually and photographically.

New generation of medico-legal experts also prepares videotapes of the post-mortem examination.

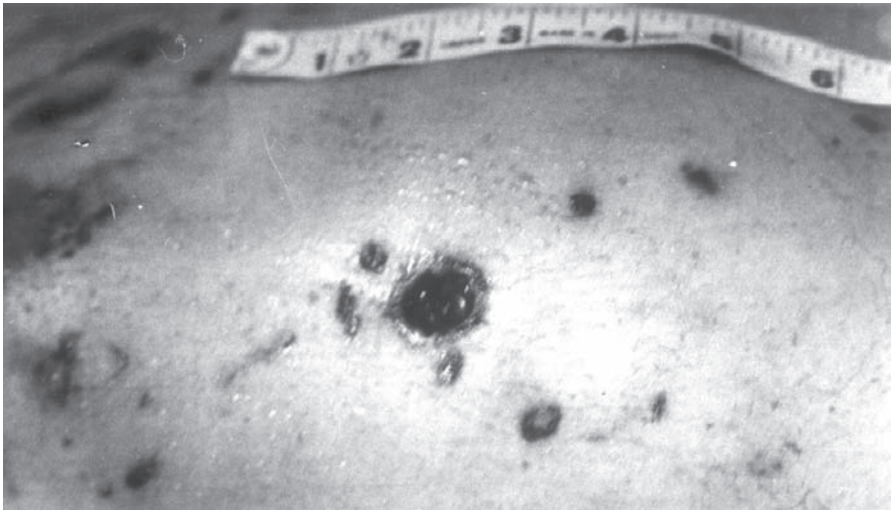


Fig. IX-3

A 12 bore shotgun injury from over 2 metres. A rat-hole surrounded by small individual holes. This is a typical injury formed by a 12 bore shotgun from about 2 to 8 metres.

2.7 Culprit

A culprit, who fired the firearm, may carry some gunshot residues. They are mainly on his hands forearms. The GSR deposit, if detected, establishes him as the shooter.

If a shot is fired through a glass pane, from a close range, some glass particles are blown back. They fall on the clothes of the culprit. They provide a strong link to connect the culprit with the crime scene. The phenomenon of the backward spurt of glass chip can determine the range of fire. The glass fragments fly backward up to a distance of about one metre.

If the culprit carries a firearm in his pocket, the firearm picks up some of the dust and fluff from the pocket in some cases. If the firearm is thrown away after the commission of the crime the firearm may be linked with the culprit through the corresponding dust and fluff found in his pockets or through fingerprints if they are found on the firearm.

A culprit sometimes secretes, destroys, damages or modifies the firearm, after the commission of crime. The fired ammunition can still be identified through previously fired ammunition if found with the culprit, on search of his house or hideouts. Thus, in 'no gun work' also the criminal can be linked with the crime, equally decisively.

In a murder case, no firearm could be recovered from the suspect. However, some previously fired cartridge cases were recovered from his house. The same firearm had fired the two sets of cartridges cases. They linked the suspect with the crime. (CH)

The culprits are tampering with the firearm increasingly. If previously fired ammunition is seized from the suspect-culprit and it matches with the crime exhibits of the instant case the culprit is linked with the crime.

The tampering of the firearm is also a strong presumption of guilt against the firearm owner, the culprit.

Sometimes the culprit throws away the firearm. In such a case, the investigating officer should adopt the route taken by the culprit on his departure from the scene. He should check the likely places where the culprit could have disposed off the firearm covertly.

The trained police dogs help to locate the firearm (and other evidence).

If the culprit is suspected to have thrown the firearm in a water body, the likely place is scored with a magnet with a pull of 40 to 100 Kg. The dragging process should be slow and systematic.

In an interesting case, a murder was committed in a thick forest, about six kilometres from the house of the suspect. The murder weapon was not located. It was thought that he had thrown it en route on his return. There were three footpaths leading to his house. Three investigators walked the paths and compared the dust on their shoes with that from the shoes of the culprit. One of the paths gave closer match of the dusts inter se. The likely places for throwing the firearm, along the path were checked and the firearm recovered from one of places. (CH)

The culprit may leave fingerprints on the firearm. If they are fingerprints of the culprit, they refute the pleas of the culprit that he did not handle the firearm that that was a case of suicide, or the firearm had been stolen.

The firearm with culprit may carry blood, flesh and skin pieces of the victim, if the incriminating firearm was fired in contact or near contact position. These body materials, through DNA profiling, can positively link the firearm with the victim.

The culprit may have stolen the firearm. If it is a standard firearm, it bears a serial number and the name of its manufacturer. The information helps to locate the owner. Even the erased or disfigured serial number/identifying marks can be deciphered through chemical and other resuscitation processes.

A few years ago, a firearm was received in the laboratory to decipher its erased serial number. The resuscitation of the number connected it with two murders. The firearm had been stolen from a police officer after killing him. The first murder had remained untraced. The second murder helped to solve the first murder also. (CH)

2.8 Live Ammunition

The live ammunition available with the culprit is useful and should be seized. It is the right ammunition for the test purposes.

The ammunition materials (lead projectile, black powder, wads, etc.) in the possession of the culprit are also seized for comparison with the material used in commission of crime through their trace elemental profiles.

3. COLLECTION

In the collection of evidence the trinity: Relevancy, Authenticity and Continuity (RAC) of evidentiary clue must be beyond reasonable doubts.

3.1 Firearm

The location and condition of firearms and related evidence at a crime scene should be photographed and before seizing and securing the evidence. Although physical evidence is important, yet safety of the investigator is paramount. It is given the first consideration.

The firearm may be loaded and can go off while being handled. The investigating officer must ensure safety. He should:—

(1) Ascertain whether the weapon is cocked, its safety catch is 'on', or 'off'. Set the safety catch on 'off' position if it on 'on' position.

(2) Consider the firearm loaded unless ascertained otherwise.

(3) Handle the firearm in such a way that even if it goes off it does not injure anybody. Thus, its muzzle should point either towards the sky or towards the ground if the latter is not paved. Nobody should be in front of the muzzle of the firearm at any time, until the firearm is found unloaded.

(4) Unload the firearm if it is loaded. Evaluate the safety aspects before unloading it.

(5) Consider the firearm safe only if one can see through the barrel and the chamber is empty.

(6) Detach the magazine (if any).

(1) Avoid transportation of a loaded firearm. It is dangerous and unnecessary.

(2) Unload the firearm with care. Take help of a gun dealer/maker if necessary.

(3) Ensure collection/preservation of all evidence (like fingerprints, blood, hair or fibers, dust/debris etc.) in/on the barrel/cylinder.

(4) Mark the 12 O'clock camber as No. 1 and other chambers are 2, 3, 4… clockwise before unloading a revolver. Record the position of each live/fired cartridge in the cylinder in terms of these numbers.

The other evidence available on the firearm should be collected systematically:—

(1) Hold the firearm from a place like the sling, ring, trigger guard or the corrugated/checkered surface on the butt so that fingerprints or other evidence is not mutilated/contaminated.

(2) Search, detach, collect and pack all the extraneous evidence like bloodstains, skin, flesh, hair, fibres, paint or dust, etc. in separate small cellophane/plastic pouches, after drying.

(3) Get the firearm checked for fingerprint from an expert who should locate, develop and collect fingerprints after removal of the extraneous evidence.

(4) Do not fiddle with the inside of the barrel. The presence or absence of rust, fouling, dust or flesh can lead to some important conclusions. Protect it by capping the muzzle. Do not plug. If anything is introduced in the barrel, the evidence may be lost/contaminated.

(5) Check the breech face of the firearm for extraneous matter, which may have come from the base of the cartridge. Photograph and then collect the material.

(6) Scratch/engrave the identification particulars (FIR No. with date and name of the police station) and the initials with date of recovery of the weapon at the prominent parts like barrel, action block or stock of the firearm. They should not be put on interchangeable parts.

(7) Get the initials/signatures of witness(es) on the firearm.

(8) Place the firearm in a cellophane or plastic sheath (if it is a handgun) and then in a box with clean rags or cotton for padding to prevent rattling of the firearm. Seal the box.

(9) Wrap a shoulder firearm in a cellophane sheet and seal it in a cloth cover.

Note:—If the weapon is to be processed for fingerprints, it is done before packing. Alternatively, it is packed in special containers such that the likely places carrying fingerprints do not come in contact with the packing material.

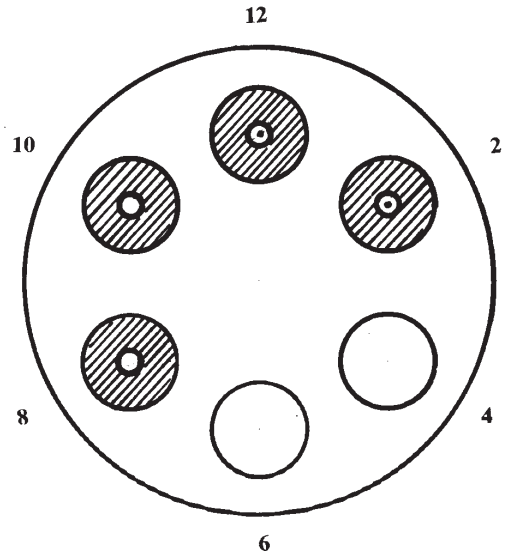


Fig. IX-4

The position of the fired and unfired cartridges should be properly recorded in a revolver. In a 6-chambered cylinder, the positions are easily indicated.
In the figure, the cartridges at 12 and 2 O'clock positions are fired, 4 and 6 O'clock chambers are empty, 8 and 10 O'clock chambers have live cartridges.

3.2 Cartridge Case

The collection of the cartridge cases follows practically same action pattern adopted for firearms. In addition, the investigating officer should:—

(1) Put his initials on the cartridge case inside with a pin so that the evidence on the outer surface is not destroyed/damaged.

(2) Record the legend found on the cartridge case.

(3) Put each cartridge case in a cellophane or plastic pouch separately (with identification data) and pack them collectively in a box with sufficient padding to avoid rattling.

(4) Mark the position of the ejected cartridge cases at the scene. This position indicates the position of the shooter.

3.3 Projectiles

The medico-legal expert extracts the projectiles from the bodies of the victims. He packs and seals them and hands them over to the IO. He sends the sealed packets (along with the specimen of seal used) to the departmental Forensic Science Laboratory, along with other exhibits, for expert examination. The IO may however request the medico-legal expert to:

(1) Establish the exact location of the bullet in the body, through X-rays.

(2) Extract the bullet with hands or with forceps having tips covered with rubber or plastic sheets. The measure prevents mutilation of the marks, etc. on the projectiles.

(3) Take out a projectile embedded in a bone, by cutting/breaking/splintering the bone in such a way that the projectile is not damaged further.

(4) Avoid prying out a projectile from its seat, if the process is likely to damage the marks on the projectile.

(5) Put identification marks (initials) on the base or on the ogive, the tapering nose end of the projectile.

In a recent multi-murder case, one of the pleas of the defence for the acquittal was that the medical officer, who had extracted the bullets and their fragments from the dead bodies, could not identify them at the time of giving the evidence. The doctor had not put his initials on the projectiles. (CH)

(6) Save the ricochet marks, extraneous matter etc. while extracting the projectile. Preserve the ricochet traces: sand, earth, paint, wood, fibre, etc. The ricocheting (bouncing) projectiles picked up traces from the surfaces from which they ricochet and become deciders of the nature of the case in some instances.

In a political demonstration, the police had to fire in the air, to disperse the crowd. Somehow one activist died. A bullet had hit the victim on his back and it was found lodged in his body. It was alleged that the police had fired at him while he was fleeing. The police maintained that they had fired only in the air.

The ricochet traces on the extracted projectile proved the public version wrong that the police killed the activist intentionally. (CH)

(7) Place the bullets in separate plastic envelopes and pack them in a suitable box with sufficient padding to prevent rattling.

Projectiles are also found at the crime scene; may be lying around or embedded in furniture/walls/floor/ceiling/roof, etc. IO collects them. He should:

a. Collect the bullet located on the scene. Pack it, after drying it in such a way that it does not rattle. Seal and dispatch it to the laboratory, observing usual procedure.

b. In case of embedded projectiles, collect the original article containing the projectile/bullet. If the article is too big, cut and collect the piece containing the bullet and send the cut piece following the usual process.

c. Call the expert to the scene to help him in taking out the bullet/projectile in difficult situations.

d. Ensure that in no case the projectile/bullet is damaged further in the extraction and despatch processes.

The damage to the projectile may hinder the correct identification.

3.4 Slugs and Shots

Slugs, shots and pellets often figure in the criminal investigations. The slugs and buckshots may carry barrel marks. While extracting them from the body of the victim or from any medium at the scene the precautions mentioned above, for bullets/projectiles are observed so that the marks are not damaged.

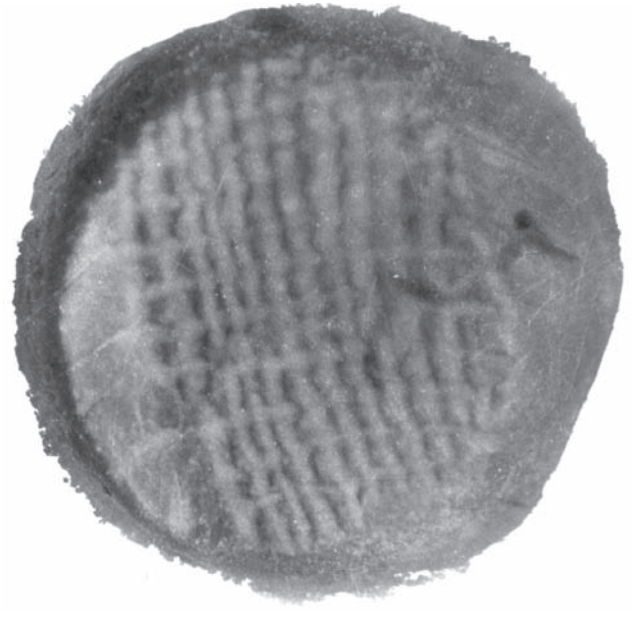


Fig. IX-5

The marks on a buckshot indicated that the projectile had passed through a window wire gauze. It helped to reconstruct the sequence of events.

3.5 Clothes

The clothes of the victim carry the projectile holes if the projectile has passed through them and the powder patterns if the shot is fired from a close firing range.

In some cases, like suicides/alleged struggles the determination of range is critical. Examination of garments for GSR becomes crucial.

The clothing of the victim needs care in their handling so that GSR and other evidence thereon is not lost or contaminated. The investigating officer should:—

a. Dry the clothes before packing.
b. Cover the area bearing evidence with a plastic sheet to prevent its contamination.
c. Put the name of the owner, the date of recovery and the identification marks at an inconspicuous place.
d. Pack the dry clothes in some sturdy dust-proof bags. Cloth bags with paper lining are useful.

The clothes of the culprit may carry important clues: hair, fibres, stains, tears, glass fragments, etc. They should also be collected and processed in the same way as other evidence with all legal formalities.

3.6 Live Ammunition

The investigating officer should collect the available live ammunition from the suspect and despatch a representative sample to the forensic science laboratory through a special messenger, after packing it properly to prevent any accidental explosion. The live ammunition is useful as test ammunition. It is similar to the ammunition used in the instant crime and hence provides better evidence.

The seizure of the live must follow the law of the land.

Postal regulations do not allow sending ammunition though post. Special courier takes it to the laboratory.

3.7 Glass Fragments

If the firing is through glass pane, the culprit picks up glass fragments. They are deposited on the clothes of the culprit, in the welt of his shoes, in his hair or embedded in the skin. They are difficult to locate and collect.

The investigating officer sends the clothes, to the laboratory. He examines his likely body parts and gets the suspect examined by a medico-legal expert.

IO collects the glass fragments found at/near the scene and send them to the laboratory in a suitable glass vial or in an envelope, packed and sealed properly. He requisitions expert help to collect them in important cases.

If the culprit has walked on the broken glass at the scene, the shoes of the culprit are likely to pick up glass particles, embedded in the soles of the shoes. They remain there for a long time. The IO sends the shoes to the laboratory.

3.8 Gun Shot Residues (GSR)[1]

The GSR is deposited on the hands of the person who fires a gun, especially if the gun happens to be a handgun. They permit identification of the shooter. The investigating officer should take the following steps:—

1. Take the suspect to the nearest forensic science laboratory, if possible.
2. Alternatively, collect the discharge residue in any of the following ways:—
    a. Deposit about 2-3 millimetre thick molten wax on the hands of the suspect. Peel off the cast, place it between two inflexible plastic sheets and join them with an adhesive tape or cement. Pack and forward the sheets in a suitable cardboard box.
    b. Swab the hands of the suspect with clean cotton wool, dipped in dilute (10%) hydrochloric acid or 5% nitric acid. Collect the washings (including the swab) in a clean glass vial. Cork the vial properly, pack and forward it to the laboratory.

1. *See* chapter 13 on *Gunshot Residues*.

c. Take previously prepared filter papers, dipped in solutions of l-naphthylamine, sulphanilic acid and citric acid, which have been dried and protected from the light. Press it after wetting, against the surface. If there are nitrite particles on the hands, pink spots will develop on the paper. They indicate GSR.

d. Use tape lifters to pick up GSR. Inert tapes are being used extensively to collect GSR. They are quite efficient and very convenient.

The hands of the victim will carry GSR, if he has committed suicide. The above drill is Repeated with the victim if suicide is alleged.

3.9 Injuries

Medico-legal experts carry out the examination of the injuries. However, the investigating officer, the court, the counsels and in certain cases the firearm experts have to understand/evaluate the injuries. Therefore, the doctor should:—

1. Get the injuries photographed before and after cleaning them.
2. Indicate the presence or absence of foreign matter, like gunshot residues around the injuries.
3. Describe whether a particular injury is an entrance (inverted edges), or an exit wound (everted edges).
4. X-ray the body to locate the projectiles in the body, if any.
5. Recover the projectiles without further mutilation; initial them at the base or on ogive of the projectile or at a place that carries no evidence. Seal them with his own seals before handing them over to the investigating officer.
6. Describe and sketch the internal track. Specify the extent of damage, bleeding and incapacitation capabilities of each injury.
7. Indicate the exact location and size of the injuries on the injury diagrams, preferably on a graph paper.
8. Collect the washings from entrance wounds with dilute hydrochloric acid (10%) or nitric acid (5%) for chemical test.
9. Collect the clothes of the victim. Put his identification marks on them, far away from the holes so that the marking does not contaminate/ spoil the GSR.
10. Identify the holes observed on them and co-relate the holes with the injuries observed on the body of the victim.

The association of ballistics expert in post-mortem examinations of gunshot fatalities will have synergic effect: proper location, collection and evaluation of the evidence.

3.10 Projectile Marks and Holes

The investigating officer should collect all articles, which bear or suspected to bear, GSR marks, projectile holes, dents or other marks. He should record the shapes, sizes, etc. of the various holes, textually, photographically and through sketches.

The investigating officer should preserve the marks, pack them and send them, carefully to the forensic science laboratory or requisition the expert help to examine the scene, especially in important cases.

Fig. IX-6

The shape, size and the destructive effect on a wind screen of a vehicle indicated that an air rifle slug had hit the wind screen. The occupant of the vehicle had alleged being shot at.

3.11 Test Exhibits

The experts prepare the test exhibits themselves. The investigating officer should not fire the firearm to get test exhibits (cartridge cases, bullets or test patterns).

The ideal test exhibits are obtained if the same firearm and similar ammunition are used for test purposes. It is a necessity in some cases. Therefore, the IO sends recovered ammunition to the laboratory.

In cases where there is no recovery of the live ammunition with the culprit/ suspect, the IO finds out the source, obtains live ammunition for test and sends the same to the laboratory.

In some cases, laboratories make their own arrangement to obtain the proper test ammunition when it is not recovered from the culprit.

4. PROBLEMS

The physical evidence, in shooting cases, consists of firearms, ammunition and the injuries. Their evaluations provide solutions/answers to many problems:

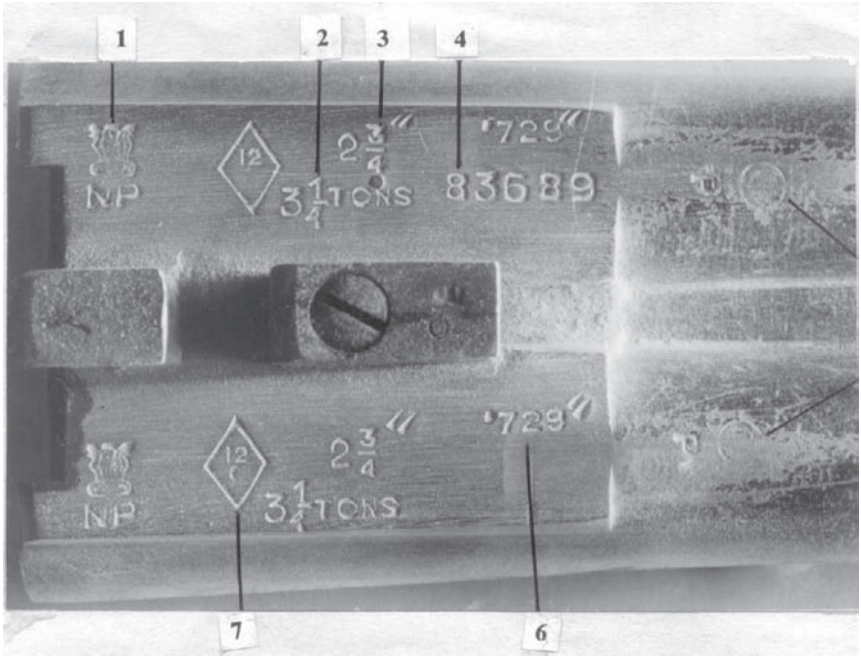


Fig. IX-7

The marks found on a 12 bore (Indian Ordnance made) shotgun.

1. *The proof marks;*
2. *The pressure (Tons/inch2), the firearm can stand;*
3. *The chamber length;*
4. *The serial number which is erased and altered when stolen;*
5. *The provisional proof marks given by the Indian government;*
6. *The bore diameter.*
7. *The gauge of the barrel. The letter 'C' indicates a choked barrel.*

4.1 Firearm

The evaluations of the firearms answer the following questions:—

1. Is the instant device a firearm as per law?
2. What are its make, model and calibre? Alternatively, is it an improvised firearm?
3. Is it in working order?
4. Is it liable to fire accidentally?
5. Has it been fired? If so, when was it fired?
6. Has it been used as a bludgeon?
7. Has it been used in some other crime(s)?
8. Can its owner be traced from its serial number (original or after resuscitation)?
9. Was it tampered? If so, how and when was it tampered?

4.2 Fired Ammunition

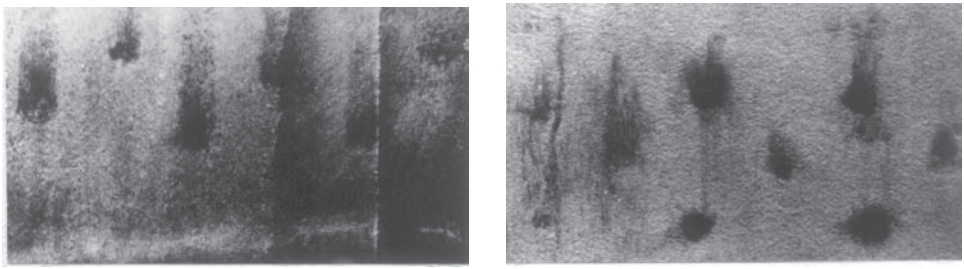


Fig. IX-8

(1) six marks left by an L.G. cartridge. (2) nine marks from an S.G. cartridge.

Marks of the buckshots inside the cartridge tube (in fired cases) may indicate the size of the shots: The marks can be recorded on a filter paper with the help of chemicals. A filter paper dipped in sodium rhodizonate solution (to record lead) is inserted in a tube form. The marks in the cartridge case are recorded as spots on the filter paper.

The fired ammunition answers the following questions:—

1. Does the ammunition carry identifying characteristics to link it with the firearm that fired it?
2. How many firearms fired the given fired bullets/cases?
3. What type of firearms fired the ammunition?
4. Was the ammunition fired from the suspect firearm?
5. What is the calibre/make of the fired ammunition?
6. Does the ammunition used in the present case correspond with the live ammunition, recovered from the suspect?
7. Is the fired ammunition, recovered from the scene and the suspect, fired from the same firearm?

4.3 Medico-legal Problems

The doctor, who carries out the medico-legal examination in a shooting case, provides answers to the following questions:—

1. Are the given injuries on the person of the injured or on the deceased gunshot injuries? If so, what type of firearm and ammunition were used?
2. Are the injuries, suicidal, accidental or homicidal in nature?
3. What is the age of the injuries?
4. What was the range (close/medium/distant) of fire to cause the injuries on the victim?
5. Are the injuries fatal individually or collectively? Alternatively, was the death due to some other cause?
6. Are the injuries in conformity with the given version of the eyewitnesses or not?
7. Did the suspected firearm cause the injuries?

8. How long could the victim survive after receiving the injuries?
9. Could the injured perform the acts attributed to him, after the injuries?

4.4 Muzzle-loaders

The problems relating to the muzzle-loading firearms are:—

1. Were the recovered fired percussion caps fired from the suspected firearm?
2. Were the shots, recovered from of the victim, cast in the mould recovered from the suspect?
3. Were the shots, recovered from the body of the victim and those recovered from the accused cast in the same mould?
4. Did the shots (or lead) recovered from the body of the victim and those recovered from the accused have the same trace elemental profiles?
5. Did the wad material, paper pieces or rags, recovered from the accused and those recovered from the scene/victim have a common source?
6. Was the gunpowder found at the scene or on the body/clothes of the victim similar to the powder recovered from the accused?

4.5 Live Ammunition

The live ammunition recovered from the suspect may provide answers to the following:—

1. Is the given material ammunition, legally?
2. What is the calibre and make of the given ammunition?
3. Is the given ammunition fire-worthy?
4. Is it of prohibited or non-prohibited firearm ammunition?
5. Is the recovered ammunition of the same make (and batch) as the one used in the crime?

5. ACCEPTABILITY

Firearms are involved in heinous crimes. If their evidence is to be accepted by the courts beyond reasonable doubt it is essential that the recovery, identity, purity and possession of the evidentiary clues are proved that their authenticity, integrity and legality is unquestionable. The IO, therefore, guards and preserves the evidence meticulously and scrupulously.

5.1 Identity

In judicial proof, it is essential that the evidence that links the criminal with the crime must be proved to *belong to the case.* Some independent witnesses, therefore, witness the recovery. If the exhibit is large enough the witnesses initial the exhibit itself. This is possible in the case of firearms and the powder patterns on clothes. It may not be possible in fired shells, bullets, etc. It may also not be desirable in the case of such exhibits as it can mutilate the evidence. Therefore, in such cases, the witness should put his initials/signatures on the packages and on the recovery memo.

The IO keeps a complete record relating to the nature, condition and size, etc. of the exhibit in the case diary. He also records the circumstances surrounding the

recovery. Besides, the place of recovery and processing is properly documented (through photography, Sketches, textual description, videography etc.).

The investigating officer, immediately after taking the possession of the piece of evidence, puts identification marks on the clue material, preserves the evidence, packs and seals it in the presence of the witnesses, who also put their initials on the package.

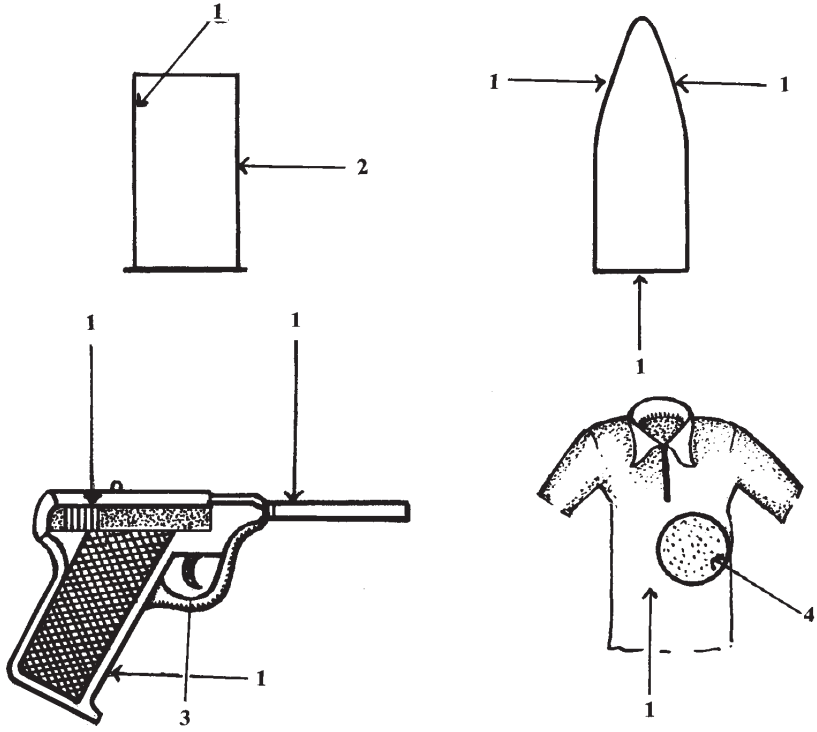


Fig. IX-9

The collected evience should be marked at correct places.

1. *Indicates the correct positions where the investigating officer should put his identification initials (marks);*
2. *Can be used by the expert, if there are no marks on the surface;*
3. *Trigger guard from where the firearm can be held without spoiling evidence;*
4. *Powder marks and projectile holes should be marked well and protected.*

The identification marks put on the evidence are scratched to prevent being rubbed off or mutilated. The lead projectiles, wads and paper or plastic shells can be marked with an ordinary pin. The metallic exhibits require a diamond pencil for marking. The clothes bearing powder pattern and bullet marks are marked in indelible ink.

An ideal way to preserve the identity of the evidentiary clues is to record the evidence photographically along with an identification chit bearing the case

number, the name of the photographer, a scale, etc. Digital photography has made it both time and cost effective. It should be adopted in all cases.

In some cases, the evidence undergoes changes. For example, injuries either heal or putrefy. The powder marks/bullet holes alter. The photograph preserves the original identity.

Fig. IX-10

The tattoo photographed identifies the victim later.

5.2 Purity

"Analysis can be no better than the sample submitted"

It is the basic law of chemical analysis. It impresses the importance of the purity of the sample. The evidentiary clues must be pure –- uncontaminated and unmutilated. The investigating officer, to ensure the same, should:—

1. Never fiddle with the evidence. Handle it to the minimum extent.
2. Never allow the curiosity hunters to handle the evidence.
3. Maintain the integrity of the evidence while handling or marking it for identification purposes.
4. Never carry the evidence in a pocket.
5. Never use dirty containers.

6. Never pack the evidence loosely. Rattling, rubbing and abrasion may destroy or contaminate the evidence.
7. Never pack the evidence under conditions, which may destroy the evidence. For example, firearms (or ammunition) taken out from water may rust if not dried before packing. Wet clothes, if packed as such, may develop fungus growth, which destroys the evidence.

A murder trial came up after considerable lapse of time. It involved a 12-bore gun and fired shells. The author had linked the cartridge cases with the firearm.

He was called for evidence. When the cartridge cases were put up to him, he found that the tubular portion, where the identifying data had been put, had rotted. He requested the court to permit microscopic examination in the laboratory to figure out the identity from the firing pin marks. The defence counsel objected to the procedure. The court did not allow.

The court did not accept the expert evidence for want of identification the crime exhibits by the expert.

*The police/court had not taken proper care to preserve the evidence. (**CH**)*

5.3 Authenticity

Minimum persons should handle the evidence. It should be transported to the minimum number of places. The ideal sequence of the movement of the evidentiary clue is that the investigating officer takes it from the scene to the expert who later produces it in the court. This is not always possible. Rather this is not even attempted except in some important cases.

The investigating officer should seal the exhibits at the scene itself immediately after the recovery, in the presence of witnesses. If the unsealed exhibits are brought to the police station there are chances of their getting mixed up.

A few years ago in a murder case, the author received exhibits consisting of an improvised pistol and two fired shells. One of the shells was identified in respect of the firearm. The other shell was not fired from it.

A few days later, in a similar case, the same police station sent another firearm and two fired shells. One shell was identified in respect of the firearm, the other was not. The expert had a mental picture of the marks on the cartridge in the earlier case. He suspected a mix up. When the exhibits of the two cases were compared inter se, it was possible to link the two cartridge cases to each of the firearm. There were no links between the two cases except, that they were being processed by the same investigator almost simultaneously.

*Obviously, the mix-up took place in the police station. **(CH)***

The sealed exhibits should be taken to the expert direct from the scene. The Punjab High Court has given sound advice on the subject.[1]

The seal used should be the personal seal of the investigating officer. He should preserve the original seal.

1. *Mohinder Singh* v. *State of Punjab,* (1961) 63 Punj LR 434.

The specimen impression of the seal used is sent to the expert, separately. A copy of the specimen seal is kept in the case file.

The seal of a local person should not be used. He may lose it. If the seal is needed again, it is forged. The court may acquit the accused, giving him the benefit of doubt. If the seal of a local person is used, it is taken into possession and kept in the case file.

In a murder case, a parcel containing the projectile had a number of seal impressions bearing the same monosyllables. When the impressions were examined closely, it was found that they had come from two different sources. The fact was mentioned in the report. The defence counsel alleged manipulation and got acquittal for his client. ***(CH)***

A thin layer of superior sealing wax is used to seal exhibits. Such seals do not peel off. Thick-layered seals peel off and can be re-affixed fraudulently. Ordinarily, the fraud not detected.

The exhibits should never be left unguarded. The interested party can steal them. A charge for theft is nothing as compared to a charge of murder.

The expert, after checking the seals, should open the sealed parcels himself and mark the exhibits including the packing cloth for identification purposes. The test exhibits prepared during the examination should also be marked likewise.

After completing the examination, the exhibits be should re- sealed and kept under lock and key in the crime property stores for the proper upkeep till they are returned to the concerned authorities.

The expert sometimes mixes up the test and the crime exhibits. He may examine the test exhibits (or crime exhibits) inter se instead of comparing the test/crime exhibits and may come to wrong findings. He should, therefore, check, before and after the comparison, whether he has compared the crime exhibits with the corresponding test exhibits or not.

It is advisable to open one case at a time. If more than one case are opened simultaneously, inter-mixing of the exhibits must be avoided.

The evidence produced in the court must be carefully preserved. Sometimes it gets lost in the court.

In a sessions trial, the incriminating shell was exhibited when one of the eyewitnesses was giving the evidence to prove that the shell was collected in his presence. The expert had examined and linked the shell with the firearm recovered from the accused. When he appeared for evidence the fired shell could not be traced anywhere, presumably. Somebody stole it from the court! ***(CH)***

In an appeal against the conviction for a murder, an extracted pellet and its radiograph assumed great importance. When the vial containing the pellet was examined, there was no pellet! When the radiograph was examined, there was no shadow of the pellet! Presumably, the exhibits had been switched at some stage! The court acquitted the accused. ***(CH)***

5.4 Chain of Possession

The chain of possession (custody) of the evidentiary clue must remain unbroken from the time the clue is seized to the time it is produced in the court. The persons holding the clue must vouchsafe the same.

An intelligent investigating officer keeps a custody log (date wise chart) for the clues. The courts have not hesitated to throw out the cases where there were gaps in the chain of custody.

6. EVIDENCE PROFORMAS

It is always advantageous to keep record of data about evidentiary clues in standard proformas. They are impressive and are useful. They prevent callousness.

The useful proformas are:

a. The evidence information proforma.
b. The evidence collection proforma (log).
c. Forwarding letter proforma (format).
d. Laboratory examination proforma (log).

6.1 Evidence Information proforma

The evidence information chart (Annexure I) gives information about the possible clue materials, their location and briefly their potential and mode of handling. The contents of the chart should be known to all those who are to investigate crime involving firearms. The chart acts as a ready referencer.

6.2 Evidence Collection Proforma

The evidence collection log is useful at the scene of crime. It gives basic Information:—

1. Crime Scene Site……
2. FIR No. with date ……..
3. Informer…….
4. Date and time for the visit of the scene…….
5. Crime scene team:
   a. Chief or leader.
   b. Members.
   c. Specialists.
6. Investigating team……..

6.3 Forwarding Letter

An authorised officer issues the letter for the expert examination of the clue materials. He must give the following information to the expert:

1. The FIR No. with date and the name of the police station.
2. Brief history of the case.
3. A copy of the FIR.
4. The details of the exhibits in each packet.
5. The description exhibits and of the seals put on the various packets.
6. The sample seals of the seal(s) used on the packets used.
7. The questionnaire on the information needed (expected) from the examination.
8. Time required for the examination and for furnishing report.

6.4 Laboratory Work Proforma

All the institutions are using the laboratory worksheet or work proforma, in varied forms. However, the extent of the information logged therein varies. The minimum information, which should invariably be recorded, is:—

1. The assigned laboratory number, usually serial number of the case.
2. The date of receipt.
3. The sending authority and its reference number.
4. The FIR number with date, police station's and the district's names.
5. The mode of receipt.
6. The dates of opening, examining, completing, reporting and resealing the case exhibits.
7. The details of the exhibits received.
    a. The number of parcels/packets.
    b. The details of the seals on each parcel: their number, condition, legible or illegible.
    c. Correspondence of the seals on the parcels with the specimens.
    d. The details of the contents of each parcel.
    e. The condition of the contents.
8. The questionnaire framed by the forwarding authority.
9. The details of the experiments performed.
10. Brief details of the observations made and inferences drawn.

6.5 Report Proforma

The report proforma likewise contains all the above information mentioned in section 6.4. It has a report number. The report (the result of the examination and evaluations), must be concise, precise and as far as possible, in set and standard language, free from ambiguity and different interpretations. The entire contents of the report should be scrupulously free from factual or language errors.

Annexure I

EVIDENCE INFORMATION CHART

Laboratory requirements

(1) Unmutilated, uncontaminated and undamaged evidentiary clues in their original untampered form. (2) Adequate samples: Firearm, live ammunition, scene of occurrence (visits, photographs, sketches, description), clothes, medicolegal report.

Evidence	*Location*	*Collection & packing*	*Identification marks*	*Required samples*	*Possibilities*
1	2	3	4	5	6
Scene of occurrence	Ascertain from disturbance, marks clues and corpus delicti.	1. Photograph 2. Sketch. 3. Description.	1. The photo data and the date on which the work was done. 2. All documents must be signed and witnessed (when possible).	Visit to the scene by an expert is useful, indespensable in some cases	1. Determination of the real or fake scene. 2. Reconstruction of events to verify the version: suicide, murder, accident or self-defence.
Firearms: pistols, revolvers, rifles, shot-guns, muzzle-loaders, toy guns, air guns, improvised guns, automatic, semi-automatic firearms.	1. Scene: floor, clothes, furniture. 2. Accused: person, residence, hide-out. 3. Victim. 4. Route.	1. Unload. Remove the detachable evidence. Process for fingerprints. 2. Encase in plastic envelope/sheet. 3. Seal in the cloth/ cloth-lined sturdy envelopes.	1. Initials with date, case number on the non-changeable and on all the inter-changeable parts. 2. Note the make and the serial number of the firearm. 3. Record the description with a sketch. 4. Photograph	——	Linkage with the fired ammunition period of fire, range, fire worthiness, accident prone, reconstructions, ownership through the serial numbers and fingerprints.
Fired ammunition: bullets, cartridge cases, pellets, wads, fragments of projectiles, powder particles.	1. Scene: floor, furniture, walls, trees may be embedded. 2. Firearms: cases, stuck up bullets. 3. Victim: bullets and pellets inside, powder marks. 4. Accused: on the person, at residence or at the testing place.	1. Collect all. 2. Encase in the plastic envelopes. 3. Seal in the cloth-lined envelopes.	1. Mark the shells inside, bullet at base or on ogival area, pellets on unmarked place. 2. Describe the exhibits.	1. Corresponding live and fired ammunition from the suspect. 2. Firearms.	1. Linkage with the firearm or the fired ammunition. 2. Number of shots. 3. Number of firearms. 4. Nature of the firearms. 5. Period of the fire.

1	2	3	4	5	6
	5. Previous owner.				
Live ammunition: powder, cartridges, projectiles, lead.	Scene, house or the hideouts of the accused.	1. Collect all. 2. Encase in plastic envelopes. 3. Seal all in the non-rattling containers.	1. Write on cylindrical or tapering portion, avoiding damage to any available evidence. 2. Describe the ammunition (quantity, condition, make, etc.)	——	1. To establish whether prohibited or non-prohibited. 2. Nature of the firearms. 3. Test ammunition.
Marks: projectile holes, powder marks, metallic deposits.	1. Victim: clothes, person. 2. Scene: floor, walls. furniture, etc. 3. Suspect: hands and clothes.	Photograph and collect marks bearing articles or their parts. Seal.	1. Mark the clothes, cover. 2. Describe.	Live ammunition and the firearms.	1. Cause. 2. Range. 3. Reconstructions. 4. Identification of the injuries, ammunition. 5. Angle of fire.
Traces: fingerprints, hair, fibres, blood, flesh and dust.	Attached with the fire-arm, cartridge cases, live ammunition, projectiles. (Also with the victim, the suspect and the scene).	(1) Collect all. (2) Encase in plastic envelopes.	1. Mark the envelope. 2. Describe the evidence.	Corresponding samples from the victim, accused, or from the scene.	Linkage of the firearm with the scene, the victim or the accused, reconstruction, range.
Firearm injuries: entrance, exit and internal wounds.	1. Person of the victim. 2. Apparel worn by the victim. 3. Objects hit at the scene. 4. Bystanders. 5. The culprit.	1. Photograph before and after cleaning. 2. Draw the graphic diagrams. 3. Differentiate the entrance and the exit wounds. 4. Collect the washing. Pack the washing in a spill-proof container. 5. Take the radiographs. 6. Describe fully (post-mortem or injury reports).	1. Initials with date and the case number by the relevant persons. 2. Keep a copy of the report.	1. Arms, ammunition. 2. Clothes of the victim. 3. Photos and the description of scene. 4. The doctor's statement 5. The victim's or the defence version.	1. Firearm injury. 2. Range. 3. One or more firearms. 4. Verification of the hypothesis: suicide, accident, murder, self defence.

Court requirements:

(1) Location of the evidence must be established through photographs, sketches and description.
(2) Recovery of the evidence must be proved through witnesses.
(3) Authenticity of the clue that it belongs to the case and it is the same recovered clue, must be proved from the time of recovery to the time of production in the court through the identification marks on the exhibits and through transport of the exhibits in the sealed packets.
(4) The record of the discovery, recovery, possession and the description of the evidence must be complete.

FORENSICS BALLISTICS EQUIPMENT

SYNOPSIS

1. GENERAL
- 1.1 A firearm museum
- 1.2 A firearm Literature Library
- 1.3 Personal Safety

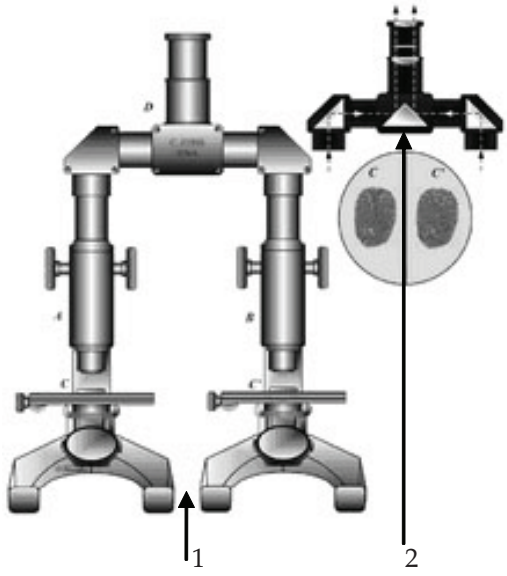
2. SHOOTING CRIME SCENE EQUIPMENT
- 2.1 Protection of the shooting scene
- 2.2 Documentation of the scene
  1. Video camera
  2. Imaging Equipment: Camera
  3. Sketching paraphernalia
- 2.3 Miscellaneous Items

3. LABORATORY EQUIPMENT
- 3.1 Preliminary Examination
- 3.2 Test Exhibit Preparation
  1. Bullet recovery box
  2. Firing range
  3. Projectile recovery water drum
  4. Chronograph for Velocity
- 3.3 Identification/Comparison of Exhibits
  1. Stereomicroscope
  2. Comparison Microscope
     (1) Mechanical Stages
     (2) Lighting Arrangement
     (3) Photographic Arrangement
  3. Modern comparison/evaluation system
  4. NIBIN (National Integrated Ballistics Identification Network).
  5. Scanning Electron Microscope (SEM)
  6. Miscellaneous Gadgets

4. PRESENTATION OF EVIDENCE IN COURTS
- 4.1 Videoconferencing (VC)
- 4.2 Power presentation of evidence
- 4.3 Virtual Reality (VR)

10

FORENSICS BALLISTICS EQUIPMENT



1. Simple early Model of Comparison Microscope
2. Comparison Bridge

1. GENERAL

Forensics Ballistics is an experimental and observational science. It needs instrumental backup. As the experiments/observations are varied in nature, the tools and techniques are also varied as per the nature/need of a particular problem. The equipment, briefly discussed here, has proven its use/utility. The details of their functioning and utility are interspersed in the text of various chapters, at relevant places.

The basic non-instrumental need, in Forensic Ballistics, is:

1.1 A firearm museum

A firearm museum should have all types (old/new) of firearms, especially those that the criminals are current using.

1.2 A firearm Literature Library

A firearm literature library should contain relevant concerned literature both in hard and soft copies on Forensic Ballistics and related fields. It should also subscribe to current firearms/ammunition.

1.3 Personal Safety

IO (or the team leader) ensures safety for the investigating team. A firearm found at the scene, may be a booby trap or defective. It may be loaded and go accidently He instructs the team that no novice will handle the firearm until it has been found safe by the senior staff. The risk can also be from the infuriated crowd gathered at the scene. The danger of planted explosives is also there, if the shooting act is by terrorists.

The IO takes the following general steps:

a. He parks the vehicle at safe place.
b. He uses safety devices to protect the team.
c. He ensures that the firearm recovered (from the scene or at the instance of the accused) is not loaded and it is safe.

The IO adopts safety measures as per need of the scene/situation. He may consult his superiors in problematic cases. Investigations start only after the scene is found safe.

2. SHOOTING CRIME SCENE EQUIPMENT

The equipment required at the shooting scene is for the protection of the scene, for its recording and for location, collection and preservation of the evidence for its integrity authenticity and continued identity. A large variety of items is needed including the following:

2.1 Protection of the shooting scene

It essentially needs crime scene tape to enclose the crime scene area. Poles are placed along the boundary and the tape is wound around them. Rope/string or the other like materials (wooden/plastic/metal board) may serve the purpose in case the crime scene tape in not available.

2.2 Documentation of the scene

The documentation of the scene is done through videography, digital imaging (photography), sketching and textual description. The equipment needed for the purpose, include:

1. Video camera

The video camera should be fully equipped to carry out the task efficiently. Thus, it should have:

1. **A battery with a long life**. Ensure it is fully charge before starting the coverage of a crime scene.
2. **A date and time display** functions on the videotape.
3. **A title generator**. If it is not available, some videotape length should be left blank at the start.
4. **A "shake free"** operational structure.

It records the shooting scene for its location, for the disposition of the various pieces of evidence at the scene and their spatial inter-relationship. Videography preserves the shooting scene indefinitely and the scene is 'portable'. The scene can be 'recreated' anywhere, anytime and for anyone. It provides transparency *vis-a-vis* the evidence and the condition of the scene to all concerned.

Videography is now being used increasingly to record the scenes of all sorts of occurrence and being dubbed **'indispensable'**. All concerned can view the entire scene in its original condition. It is a boon to the court and the counsels. They can view the scene in the courtroom itself and appreciate the scene and the evidence therein in all aspects.

2. Imaging Equipment: Camera

High pixel Digital Single Lens Reflex (DSLR) 35 mm cameras are the order of the day in crime scene photography. The essential accessories are wide-angle lens, telephoto lens, close up attachments; flashgun, photoflood lamps, exposure meter (if the camera is not fitted with one) and a tripod stand (collapsible) can handle almost all types of scenes adequately. A separate flashgun is helpful. Cameras with zoom lens are more convenient than without zoom lens. Wide-angle lens covers even small closed areas like bathrooms and kitchen adequately; the telephoto lenses can photograph evidence even in deep wells and ditches or at heights. The photographic process is quick, the storage capacity of the memory card is tremendous, and hundreds of shots can be taken without changing the memory. There should be additional lenses (close-up/telephoto/zoom), with additional memory cards, back up battery, remote flash, flashlight, portable lighting, tripod and remote cord. In important cases, a backup camera is also part of the shooting scene arsenal.

3. Sketching paraphernalia

A measuring tape, drawing board, a ruler, a geometry box, graph and drawing paper, pen, pencil and eraser should ordinarily meet all the situations. Most of these items can be gathered at the shooting scene also.

The inspection report, video-film and photographs of the scene also facilitate sketching it should also be given. They give complete overall picture of the scene to the sketch specialist and help him to draw a more factual sketch.

Electronic sketching has come up. It required:

(1) A computer or laptop and relevant software

(2) Sketch Software. Several CAD based programs are commercially available to draw accurate sketches/maps of the shooting scene. With the extensive use of laptops such sketches can be prepared at the crime scene itself. Alternatively, the sketch can be created in the office from the rough sketch of the investigating officer.

(3) Some software cannot only draw sketches but it can also incorporate the images of the evidentiary clues accurately at the right sites and correct positions in the sketch.

In India, the police is yet to induct the electronic mode. However, the clarity of the sketches, their accuracy and time and cost-effectiveness is bound to start the mode in the coming times.

The software is capable of drawing two or three dimensional sketches, As it can introduce the relevant facsimile of the evidence in the sketch itself at the correct sites it eliminates the need of the symbols, letters, digits and legend, which are a must in the hand-drawn sketches.

(4) Computer for Sketch:

The data is collected from the scene. A computer specialist, in a Forensic Science Laboratory, converts the data into a proper sketch. One can start with the exact crime scene template and choose from floor plans of houses, offices, and apartments or outdoor or commercial crime scenes like alleys and offices. Next, drag-and-drop any of the thousands of ready-made legal facsimiles of evidentiary clues: weapons, gloves, blood splatter, and even dead bodies.

2.3 Miscellaneous Items

The IO, ordinarily, carries an investigation bag to the scene. This bag contains a number of kits and other items, useful to locate/identify/collect evidence. The prominent items include:

(1) Hand magnifier, platinum needle, spatula.
(2) Strong light torch.
(3) Evidence Identification Markers.
(4) Measurement Instruments.
(5) GSR collection/testing kits.
(6) Blood collection/test kit, (scalpel handle, tweezers, etc.)
(7) Fingerprint kit. Usually, fingerprint expert attends to the work.
(8) Making/breaking kit.
(9) Packing Material (like clean unused paper bags, envelopes, metal cans, tape, rubber bands, etc.)
(10) Specimen Containers.
(11) Evidence Seal/Tape.
(12) Recording Device.
(13) Watch.
(14) Waterless Hand Wash/Disinfectant.
(15) Communication Equipment.

The IO (or a SIT) locates/collects/preserves/packs/seal the evidence, using the above equipment. He, then, dispatches the evidentiary clues to the assigned Forensics Institution for analysis/evaluation/comparison and to link (delink) the evidence with the shooter/victim/shooting scene, etc.

3. LABORATORY EQUIPMENT

A comprehensive Forensic analysis of the evidence needs many instruments, including those mentioned under the following heads:

3.1 Preliminary Examination

For preliminary examination, the equipment mainly used is listed below:

1. Hand Magnifier. It is perhaps the first device, with which the examination is started. It may or may not be fitted with strong light source.

2. Observation Table. It is a large white topped table fitted with a shadowless lamp with strong light. Guns/clothes/shot pattern/powder pattern are examined on this table.
3. Stereomicroscope. It is fitted with a long flexible arm, capable of 360^0 movement and observation. It is a useful adjunct to the Observation Table.
4. A normal stereomicrope for preliminary examination of almost all types of firearm related evidence is very useful.
5. Measuring tape/scale.
6. Calipers/micrometers.
7. Accurate sensitive balance (Sartorius).
8. Gloves/gas mask.
9. UV lamp. It is another important gadget used in the examination of stains, powder marks, GSR, etc. on the clothes and on other surfaces.
10. Strong sources of micro/macro/normal lights.

3.2 Test Exhibit Preparation

The main test exhibit generating devices are:

1. Bullet recovery box

Bullet recovery box is about 2 metres long and about 25 centimetres square in cross section. It is divided into five or six compartments, each one separated by filter paper sheets. The compartments are filled with clean cotton. There is a lid at the top, which is in place when a firearm is test fired. It is lifted when the bullet is to be located in the box after firing. One of the two square sides is open and form the front face of the box through which the test ammunition is fired.

When a test bullet is required, the front face is covered with a cardboard sheet and a shot is fired into the box. The bullet, due to the spin, forms a ball of cotton around itself when it comes in contact with cotton in the box. The cotton ball protects the marks from mutilation and slows down the projectile to a stop, because of the increase in cross-sectional area, etc. The bullet stops at various distances in the box, mainly depending upon the muzzle velocity, the spin rate and the structure of the projectile.

The experts, in India, use mostly a Bullet Recovery Box.

2. Firing range

Firing range is a secluded place where firing can be done safely. The following test exhibits are prepared at the range**.**

a. **Fired Cartridge Cases.** The firearm is fired in the open upward, preferably at a shooting range. Thus, the cartridge cases are left with the shooter and the projectile(s) flies away.
b. Trajectory Determination.
c. GSR range determination.
d. Pellet spread patters to determine the range of fire in shotgun fires.

3. Projectile recovery water drum

In some countries/laboratories, a water drum is used to recover projectiles. It is a large tank/drum, usually with a conical false bottom with a port.

It is filled with water and the firearm is discharged through the port. The projectiles settle down at the bottom, from where they are retrieved.

It is used for test bullets, test slugs, buckshots and pellets, etc.

4. Chronograph for Velocity

The modern chronograph consists of two sensing areas called *chronograph screens*, which contain optical sensors that detect the passage of the bullet. The fired bullet passes through both screens, and the time it takes the bullet to travel the distance between the screens is measured electronically. Thus, we have velocity:

$V = D/t$

3.3 Identification/Comparison of Exhibits

1. Stereomicroscope

A Stereomicroscope works upon the simple principle that the shape and structure of any article or surface can be perceived better with two eyes, in a natural way, rather than with one eye only. An ordinary microscope, with one objective, furnishes a flat image of the object under observation. There is no perception of depth of the field. The lacuna is remedied in a stereomicroscope.

Stereomicroscope has two objectives. They form two separate images. The positions of the objective lenses are so arranged that the images formed overlap to the same extent to which the images formed by the lenses of the eyes overlap. The effect is the three dimensional image, as is the image formed by the eye lenses. The perception of depth is better. Consequently, clarity and inter-spatial surface is better. It gives a **'live'** picture of the marks.

High magnifications reduce the stereoscopic effect in the images. The highest useful magnification limit is about 100 X though magnifications up to 150 X are also utilised.

2. Comparison Microscope

If a firearm laboratory is asked to choose only one instrument for its work, the choice shall be a comparison microscope. The instrument is indispensable for quick, efficient and presentable linkage of the firearms with the fired ammunition.

The principle on which the instrument works is simple. The comparison of the two sets of marks is facilitated if they are magnified to the same extent and brought in juxtaposition in the same plane, in an eyepiece or on a screen, simultaneously. This is achieved in a comparison microscope.

Comparison microscope consists of two low power compound microscopes with matched optics. A comparison eyepiece **'bridge'** brings the two images of the crime and the test exhibits, so formed, to the side-by-side position with the help prisms.

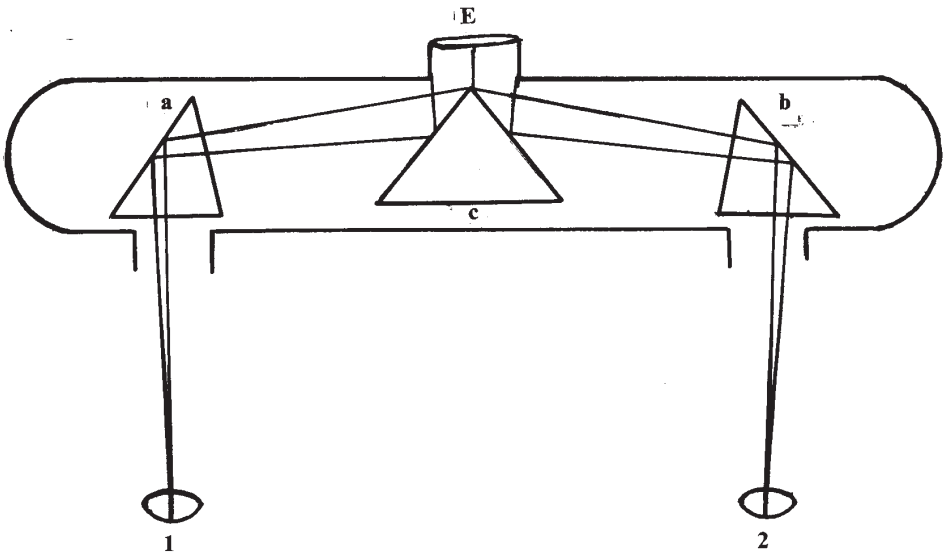


Fig. X-1

The principle of comparison microscopy. The incriminating evidence is placed under objective (1) and the image is transmitted to the eyepiece (E) through prisms (a) and (c). Similarly, the test evidence forms an image through objective, of the same specifications (2) and is transmitted to the eyepiece (E) through prisms (b) and (c). It is seen side by side with the first image. The identity or the non-identity is established by visual comparison or by projecting the image over to a screen (not shown in the diagram).

The construction of a modern comparison microscopic is complex. The above optical system has been modified and improved. The optics of a comparison microscope has now a number of objectives and eyepieces, which can be brought into position and can be focussed just by the turn of a wheel or knob independently to give a number of combinations of the objectives and the eyepieces. Ordinarily, three pairs of objectives and three pairs of eyepieces are provided. They cater for most of the needs of the firearm comparison microscopy. However, additional arrangements for incident light, phase contrast and fluorescent lights are also provided in the modern instruments.

The complete optical system is fixed on a vertical column. The microscope as a whole can thus, be moved up and down to cater for the different sizes of objects.

The instrument has been made more efficient and versatile by providing a number of additional gadgets.

(1) Mechanical Stages

There are two mechanical stages below the two objectives. The stages have the vertical (up and down), circular and lateral (both transverse and longitudinal) movements which are independent of each other and of the optical system. They can also be tilted/slanted. Thus, the objects placed on the stages can be examined and compared at different points, at all angles.

(2) Lighting Arrangement

Proper lighting arrangement is a prerequisite in all microscopic work. Here the preferred arrangement is a separate light arrangement for the two stages. It is necessary that the spotlight should be movable in all the directions and can even be tilted so that the light can be thrown at the exhibits at all the desired angles. Besides, it should be possible to vary the intensity of the illumination so that if the surfaces on the crime and test exhibits show different reflectivities, a matched illumination can be achieved by varying the light intensity in one of the two lights. The variation is achieved through a regulating transformer.

The arrangement for the examination of exhibits with ultraviolet or infrared rays has also been introduced to make the microscope more versatile. They are, however, needed only rarely in the type of comparison work carried out with a comparison microscope in Forensic Ballistics.

(3) Photographic Arrangement

The observations made in a microscope can be recorded photographically. A photograph can convince the court better and more easily than verbal descriptions. Some courts, in India, want that the photographs should be produced, while giving evidence.

In most of the comparison microscopes, both fixed plate and 35 mm cameras are used. The image is examined through a telescopic micro attachment. However, a bellow type of camera and a reflex arrangement (as in Leitz microscope) is far more convenient. Recently, monitors, as in computers, have also been introduced, along with printers. They are equally good and more convenient for observations and photography.

3. Modern comparison/evaluation system

The modern comparison microscope has inducted many innovations including the following:

(1) Digital imaging.

(2) Video facility.

(3) Visualization tools which help to assess the degree of similarity.

4. NIBIN (National Integrated Ballistics Identification Network).

It is the system though which automation in the identification and comparison of marks on fired ammunition has been achieved through computers and Internet.

The system involves:

(1) Digital photography of the marks on the fired cartridges and bullets, through dedicated microscopes. The microscopes are alike at various data collection centres, known as Data Acquisition Station, Remote.

(2) Transfer and file the digital data systematically to a computer.

(3) Generation of new data of newly seized fired cartridges/bullets. Exactly similar conditions and the same set of instruments are used.

(4) Computer comparison of the new data with the stored data gives a few hits. It indicates the match.

(5) Experts check the computer comparison hits to confirm/reject the hits the identity or non-identity of the marks on the newly collected fired ammunition.

NIBIN system has the following sub-systems:

1. **Data Acquisition System (DAS) Remotes**

   The system acquires the new data from the cartridges and bullets with the help of a dedicated microscope. The data is digitized and stored in the computer. There are a number of DAS Remotes. All the gadgets used in data acquisition at the DAS Remotes are alike.

2. **Regional Servers**

   The data and images collected by the DAS Remotes are stored at the regional servers.

3. **Match Points**

   Match Points are the centres where the comparison of the newly acquired data is done with the data the NIBIN has already stored in their computer. Computer gives hits, which are verified by the experts at the centre.

4. **Rapid Brass Identification (RBI)**

   In certain police jurisdictions, DAS Remotes may not be available. NIBIN has organised a special facility to collect the data from such places. RBI unit collects the data from such a place.

   All the workstations and the RBI units are inter-linked through Internet.

   NIBIN system is a sort of fingerprint bureau for the 'thumbprints' of firearms. The identifying data from all the licensed factory-made firearms, before they are sold, is generated. It is stored in the computers of the NIBIN.The data is used to identify the offending firearm abused in a crime through fired ammunition left at the scene.

   The Integrated Ballistic Identification System (IBIS). IBIS® is the trade name of IBIS System, developed and marked by Forensic Technology, Inc. It is an image analysis system for acquiring, storing and analyzing the images of bullets and cartridge cases. The system is comprised of two modules:

   (1) BULLETPROOF® for bullets, and

   (2) BRASSCATCHER® for cartridge cases.

The system captures video images of bullet striations and the markings left on cartridge cases, which produce an electronic "signature" stored in a database. Networking hardware and software allow transfers and comparisons of forensic evidence from different cities and countries.

5. Scanning Electron Microscope (SEM)

The use of Scanning Electron Microscope in Forensic Ballistics has profound impact on the entire field of Forensic Ballistics. It is because:

(1) It gives high resolution. It is about 300 times more than that in the optical instruments.

(2) It has extremely high depth of focus. Thus, the images give 3-dimensional effect.

(3) It has almost unlimited magnifications

It is an instrument of choice for the examination of all sorts of microscopic surface characteristics involved in Forensic Ballistics.

EDX, an accessory device, has increased the utility of the instrument many times.

The working principle of the technique is simple. A beam of electrons is impinged on the surface. The extent, direction and intensity of secondary electrons emitted by the surface depend upon the surface structure/composition of the surface in question and the original beam. The secondary electrons scattered by the surface are utilised to build up the image of the surface.

The excellent discrimination qualities/sensitivity/specificity of the microscope is making it indispensable in the examination of:

(1) Marks on fired ammunition,

(2) GSR,

(3) Bullet marks/hoes, etc.

The scanning electron microscope requires high vacuum (2 x 10–5 mm Hg). In the ordinary atmosphere, the electrons are absorbed by air. The exhibits, therefore, are placed in vacuum. They must also be non-volatile and good conductors.

The area of the sample, which can be scanned, is about 8 cm square. The positioning of the exhibited is done by remote control.

The magnification range varies from 5 X to 100,000 X. In forensic ballistics, the magnifications beyond 1000 X are rarely needed. The resolution of the order of 200 A is achieved at 50,000 X.

Fig. X-2

A typical SEM instrument
(with EDX detector, electronics console, and visual display monitors)

The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens. The signals that derive from electron-sample interactions reveal information about the sample including external.

6. Miscellaneous Gadgets

Some of the older instruments, which are now more or less of historical interest only, are:

(1) Comparison Camera
(2) Periphery Camera
(3) Striagraph
(4) Digital Calipers
(5) Digital Micrometer
(6) Professional S L R with numerous lenses
(7) Gas pressure measuring instrument
(8) Spring balance to measure trigger pull
(9) Barreloscope

4. PRESENTATION OF EVIDENCE IN COURTS

The traditional and current modes[1] of presentation of Forensic ballistics evidence are:

(1) A written report about the findings is submitted to the court. Usually it does not contain detailed reasons or illustrations. The court may summon the expert to personally present the report and justify the given findings.
(2) The expert may present the evidence orally along with a brief written report. He may/may not present identification data/illustration. The main advantage of personal presentation of the evidence is that the examined/cross-examined/re-examined. He is also often asked to provide additional evidence.

Both the processes do not require instruments, except perhaps a hand magnifier. The instrumental presentation has come up recently.

4.1 Videoconferencing (VC)

Videoconferencing allows persons from two or more locations to communicate by simultaneous two-way video and audio transmissions. Videoconferencing uses audio/video telecommunications to bring people at distant places together. Besides the audio/visual transmission, the person conferencing can share photographs/documents to illustrate and display information on whiteboards.

Videoconferencing is being increasingly used for video conferencing in the conduct of conferences. It is also being inducted in the courts to record evidence of witnesses who are far away, even in foreign lands. A set of simultaneous two-

1. Kindly see chapter 23: 'Forensic Ballistics in Courts'.

way video and audio transmissions (telecommunication technologies!) allows interchange from two or more locations. It has been made possible by:

(1) Availability of low cost equipment,

(2) High capacity broadband telecommunication services,

(3) Powerful computing processors, and

(4) Video compression techniques.

Videoconferencing is a potent mode for presenting/recording the evidence of witnesses located at distant places and it is being used increasingly.

4.2 Power presentation of evidence

The Power presentation of evidence has become possible by computer. The evidence text/tables/graphs/illustrations/photographs are converted into slides and displayed with appropriate speed/size. The presentation has more effective/impressive impact.

4.3 Virtual Reality (VR)

Virtual Reality (VR) has been defined as *"...**a realistic and immersive simulation of a three-dimensional environment**"*. It is an excellent mode to reconstruct the shooting crime scene. However, it has ample scope for misuse.

It uses interactive software and hardware in computers. The software generates realistic images, sounds and other sensations that duplicate the occurrence. The specialist interacts with this space and objects depicted therein using specialized display screens or projectors and other devices.

Some notable features of Virtual Reality presentations are:

(1) Virtual realities are displayed/presented on a computer monitor/a projector screen/a virtual reality headset.

(2) Virtual Realities artificially create sensory experiences, which can include sight, touch, hearing, and, less commonly, smell.

(3) Some simulations include additional sensory information and provide sounds through speakers or headphones.

(4) Professional VR video cameras can capture virtual reality environment with special software.

In presentation of the shooting crime occurrence, virtual reality animated films are highly convincing. They will be used more frequently in the coming times.

ARM-AMMUNITION LINKAGE

SYNOPSIS

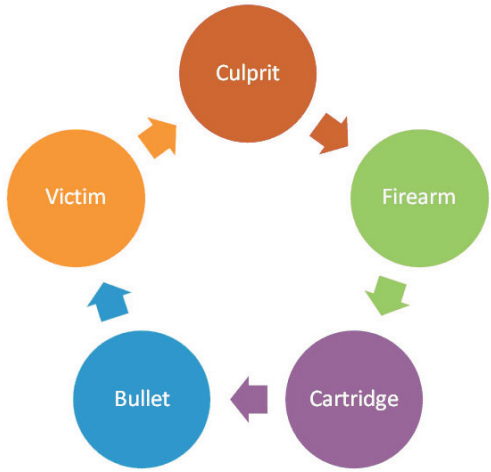
1. GENERAL
- 1.1 Principles
- 1.2 Class and Individual Characteristics
- 1.3 Identification Basis of the Fired Cartridge
  1. Firing Pin
  2. Breech Face
  3. Chamber
  4. Extractor
  5. Ejector
- 1.4 Identification Basis of Bullet
- 1.5 Identification Basis of the Buckshots

2. TEXT EXHIBITS
1. Test Bullets/Projectiles
2. Test Marks from Smooth Bores
3. Cleaning

3. EXAMINATION
- 3.1 Visual Examination
- 3.2 Stereomicroscopy
- 3.3 Comparison Microscopy
- 3.4 Comparison
  (1) Side by Side (juxtapose) Match
  (2) Composite Match
  (3) Superimposition Technique
  (4) Computer Comparison
  (5) Comparison Camera
  (6) Periphery Camera
  (7) Scanning Electron Microscopy
  (8) Striagraphy
  (9) Cast
  (10) Macro-photography
  (11) NIBIN System

11

ARM-AMMUNITION LINKAGE



The linkage

1. GENERAL

The identification of the firearm, which fired the incriminating cartridges, bullets or other projectiles, is the most important aspects of forensic ballistics. The identifications or non-identifications, like fingerprints, are definite in most of the cases. They have great evidentiary value in linking the criminal with the crime.

1.1 Principles

When a firearm is discharged, a cartridge case comes in close contact with the firing pin, the breech face, the extractor, the ejector and the chamber. The fired projectiles come in close contact with the lead and the barrel. These parts of a firearm are usually made of steel. During their manufacture, these parts undergo processes like cutting, hammering, reaming, grinding, filing and polishing. Various tools are used for the purpose. The surface profiles of the tools used continue to change due to wear and tear as the tools work on steel. The finished surface profiles of the relevant parts of the firearms after undergoing such operations are, therefore, different *inter se,* even when the two surfaces are made with the same set of tools, one after the other. Consequently, all the firearms, even the two barrels of the same firearm, are individualistic, unique. Colonel Goddard provided experimental proof:

A long steel rod was bored and grooved. It was cut into six pieces to make six barrels of six different firearms. Bullets fired through the six barrels were identified correctly in respect of each individual barrel. (CH)

The peculiarities of the various parts of a firearm are enhanced with the use of the firearm due to wear and tear and accidental damage. When a cartridge is fired, the cartridge case and the bullet come in close contact with the relevant parts of the firearm. A negative profile of the surface (of the firearm) is imprinted on surfaces of the fired cartridge case/projectile when the two surfaces come in close contact with force. The negative profile is called the thumbprint of the firearm. It permits its linkage with the used firearm only.

The materials used for cartridge cases/projectiles are softer than the steel of the firearm. The marks producing surfaces of the firearm, therefore, do not change substantially for a long time or with continued use. The firearm is identifiable, in respect of the fired ammunition, even when the firearm is recovered after a long time. The interval between the commission of the crime and recovery of the firearm is, ordinarily, too short to allow extensive changes in the barrel surface.

If the firearm is ill kept, misused or intentionally tampered with to change the surface profile, the act may hinder/prevent the linkage of the fired ammunition with the firearm.

In a murder case, the firearm was buried underground for many months. After careful cleaning, it was possible to identify the fired bullet, in spite of the fact that the firearm had rusted extensively from outside. (CH)

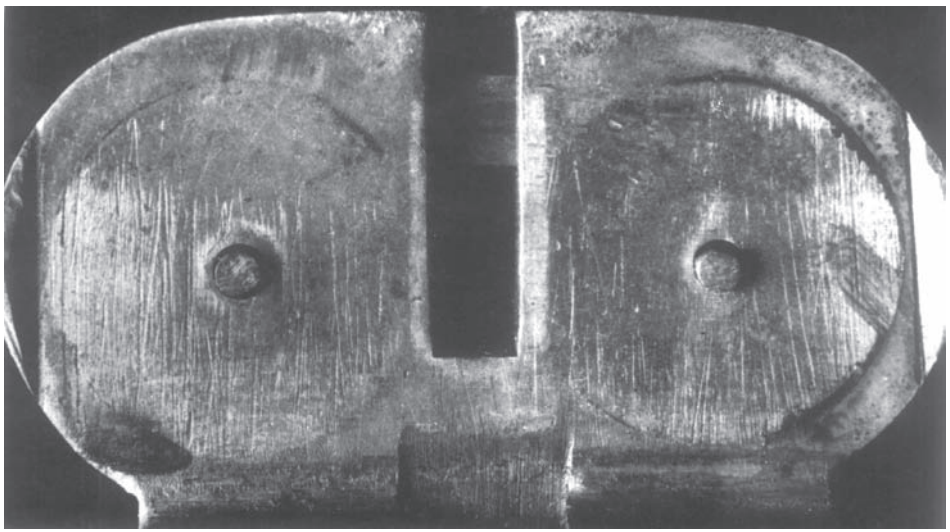


Fig. XI-1

The firing pins of a double-barrelled 12 bore gun were filed. The scratches on the breech face bear witness to the act.

Sometimes a very old firearm is used in the commission of crime. Due to extensive use, the inner surface of the barrel of the firearm is 'washed'. Its bore becomes larger. A bullet fired through such a firearm does not 'house' properly in the barrel. It, consequently, is not imprinted with the complete thumbprint of the firearm. It may/may not be possible to link the bullet with the used firearm.

A loose fit bullet is marked imperfectly. A test bullet of the right calibre, therefore, may not carry all the marks from the barrel. A lead bullet (or a slug) of slightly larger diameter is prepared and pushed through the barrel. It takes up most of the marks from the barrel and proves useful for comparison in some cases.

1.2 Class and Individual Characteristics[1]

The position, size and the general shape of the firing pin, the breech face, the extractor, the ejector and of the chamber marks on a cartridge are the class characteristics of the firearm.

The finer marks on the fired ammunition constitute the individual features (characteristics) of the firearm. They are always different from different firearm. It is against this background the ballistics experts stress:

No two firearms, even of the same make and model, produced one after the other, will leave identical marks on the fired ammunition.

In a fired bullet, the calibre and the number, width, depth, direction, angle and twist of the grooves and lands form the class characteristics. The finer details (striations) in the lands and grooves are individual characteristics of the firearm.

The firearms of the same make and model imprint common class characteristics on fired ammunition. The firearms of different makes or of different models of the same make, usually, imprint different class characteristics. The individual features are always different. No two firearms have the same individual characteristics.

The class characteristics are useful.

Firstly, they permit quick elimination of a suspected weapon, if the weapon has different class characteristic to those on crime ammunition.

Secondly, they indicate the nature and the possible make of the firearms used.

1. Scott Doyle has compiled extensive data on class characteristics found on fired bullets and cartridges. It can be studied or un-loaded from: *www.firearmD.com*

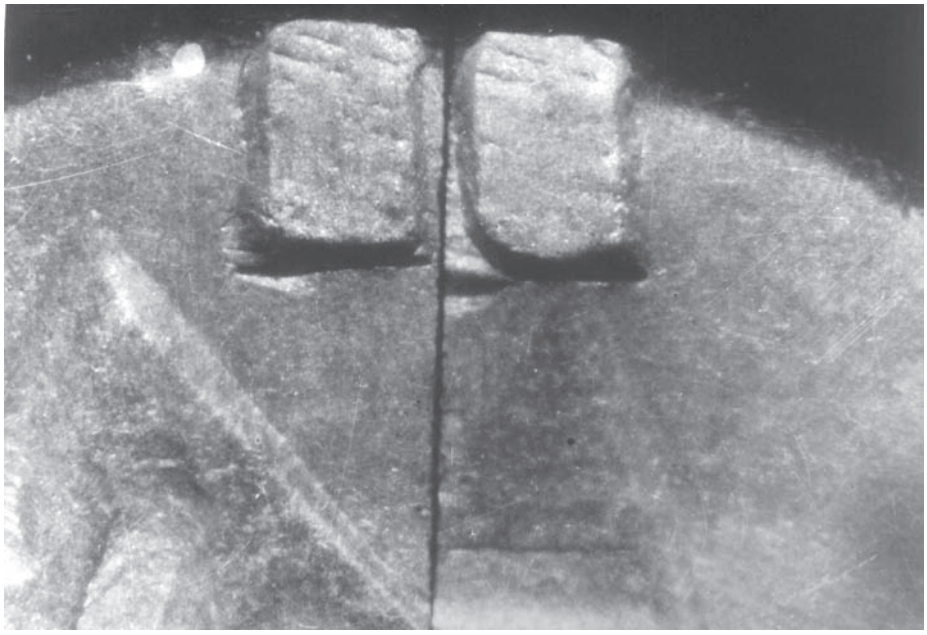


Fig. XI-2

Rim-fire firearms leave the pin mark on the rim.
The pair of pin marks shown above, show the identity of the common source.

1.3 Identification Basis of the Fired Cartridge

The cartridges when fired, as already seen, come in close contact with certain parts (the firing pin, the breech face, extractor, ejector and chamber) of the firearm. The parts imprint their negative facsimile on the cartridge case. Alternatively, if some part of firearm scrapes the case, striated marks are created on the case.

1. Firing Pin

The firing pin strikes the cartridge on the percussion cap and imprints its mark. The impact explodes the cap composition. The flame and the heat produced, rapidly convert the propellant charge into gases. The high pressure developed presses the case against the firing pin. The clarity of the firing pin marks is thus, enhanced.

The firing pin scrape marks produced on the base are equally useful. Firing pin scrapes the base of the cartridge when the breech is opened to take out the cartridge case. Marks are found mostly on the percussion cap when hammerless guns are fired and cartridge cases are extracted.

The firing pin marks alone permit the identification of the firearm in about 95 per cent cases.

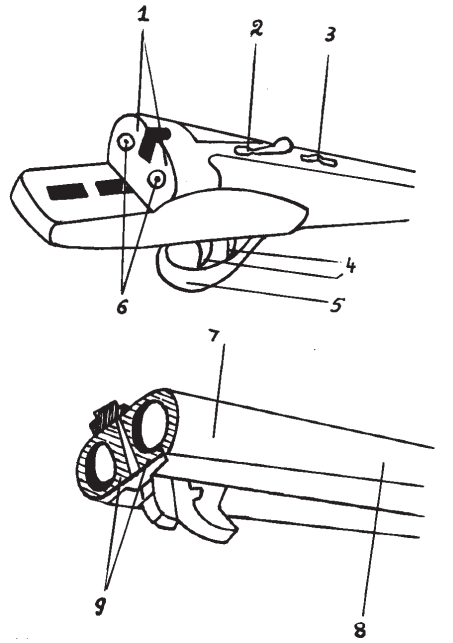


Fig. XI-3

Important Parts of a Shotgun

(1) Breech faces; (2) breech lever; (3) safety catch with indicator (4) triggers; (5) trigger guard; (6) firing pins; (7) chamber; (8) barrel; (9) extractors.

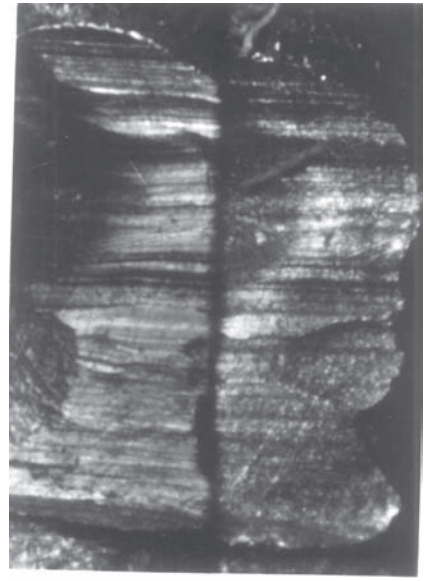


Fig. XI-4

Firing pin scrape marks continuity across the dividing line on the 'crime' and the 'test' cartridges, indicates the common source of marks.

2. Breech Face

The surface of the action block surrounding the firing pin (and opposite to the cartridge base in a loaded gun) is breech face. On firing, the gases push the cartridge case violently against the breech face, which imprints its negative profile on the cartridge base.

The breech face profile is highly characteristic. It, alone, is sufficient for the identification of the firearm used if the profile on the base of the cartridge is clear.

The breech face marks are often absent on the cartridges which develop low pressures. When the ammunition develops high pressure, breach face marks are printed.

The ammunition fired from improvised firearms, frequently, carries breech face marks, which are often sufficient to link the firearm with the fired cartridge.

The high velocity rifles and automatic and semi-automatic firearms, ordinarily, imprint identifiable breech face marks on the cartridges fired from them.

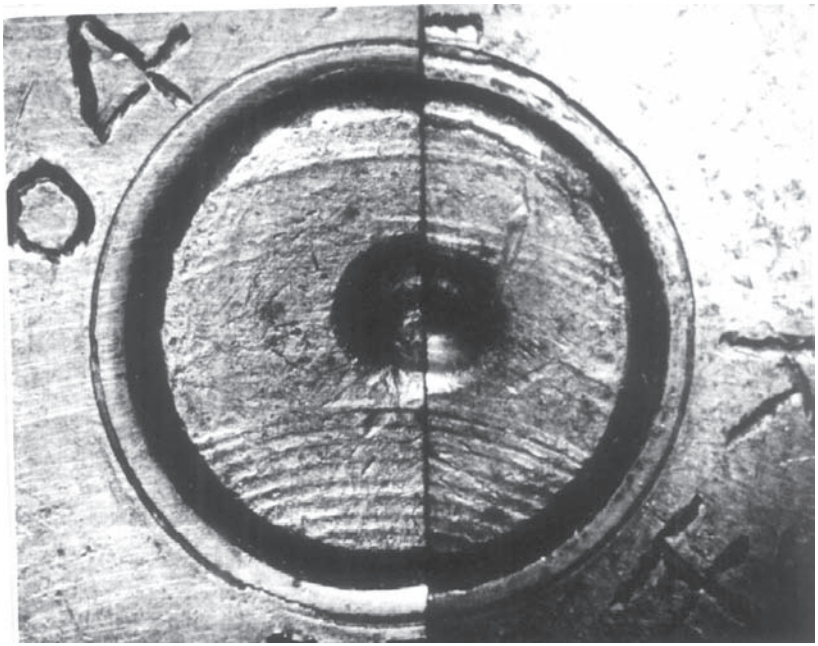


Fig. VI-5

Breech face marks establish the identity of common source; the pattern and the striations match.

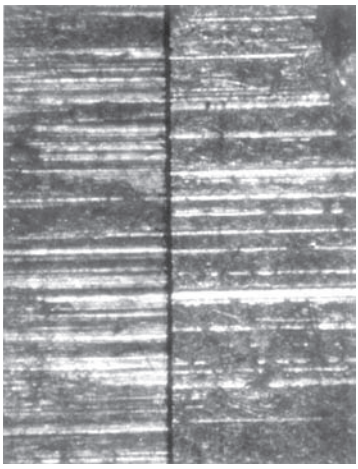


Fig. XI-6

Breech face marks establish the identity of common source; the pattern and the striations match.

3. Chamber

The standard (made to specifications) factory made firearms seldom leave chamber marks on the fired ammunition. When the chamber has some defect or some deposit it imprints its negative profile on the tubular portion of the cartridge case. An over-sized cartridge (case) may also register chamber mark. Improvised firearms often create chamber marks on the cartridges fired from them, because there is no adequate space for the normal expansion of the cartridge case, on firing. The chamber marks permit the linkage of the firearm with the fired cartridge.

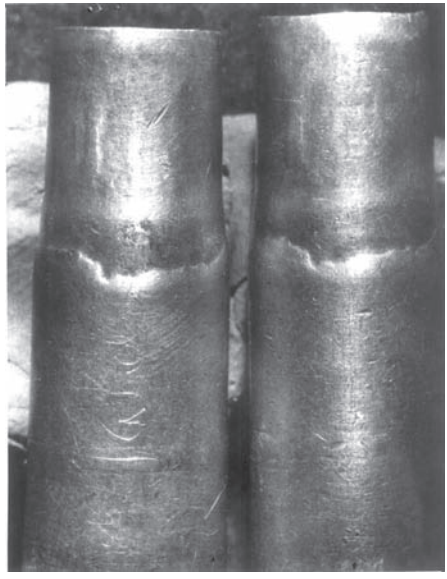


Fig. XI-7

Characteristic chamber marks identify the common source as decisively as the other marks. But the chamber marks are not common. Ordinarily, only the defective or the improvised firearms leave chamber marks on the fired ammunition.

In India, conventional structure of chambers continues. Western countries and China has modified the internal structure of chambers, in some firearms:

1. Chambers are over-sized.
2. The chamber is fluted. It may be simple flute or may be helical.
3. The chambers are perforated.
4. Annular rings are created.

The changes in the chambers are intended to accelerate/retard the cartridge case. Cartridges fired from such modified chambers, carry characteristic marks. They are useful to link the cartridge case with the firearm.

The clarity of the marks varies and depends upon the nature of the charges, the pressure developed in the firing process, the nature of the tubular surface of the cartridge and the size of the chamber.

4. Extractor

Extractor marks, like chamber marks, are rarely significant. They may permit the identification of the firearm, in some cases, whenever the prints are clear. Extractor marks help in fixing the orientation of the cartridge in the chamber. The orientation is often helpful in locating the part of the breechblock (or other parts) which may have imprinted the marks on the cartridge case.

5. Ejector

In automatic and semi-automatic firearms, the ejector stamps its marks on the cartridge case when it strikes against it, in its backward motion. The ejector is so positioned that the fired shell, after striking the device, is pushed out of the firearm. The ejector marks may link the fired shells with the used firearm. The clarity of the marks, however, varies tremendously from one firearm to another and even from one shot to another in the same firearm. The marks are, therefore, more useful as class characteristics to fix or eliminate the brand of the firearms.

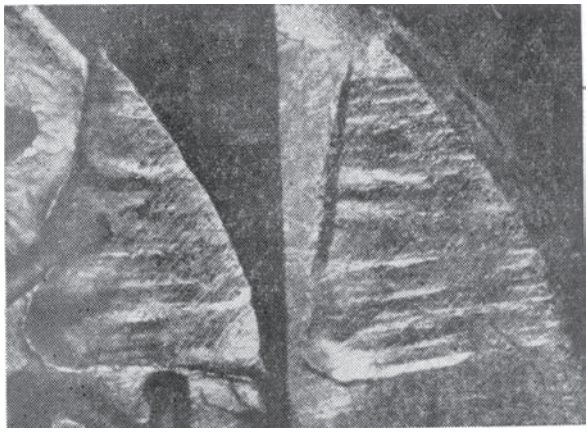


Fig. XI-8

Clear ejector marks are rare. But when present, they establish the common source.

1.4 Identification Basis of Bullet

The bullets receive marks from the barrel. The lands of the barrel engrave grooves on the bullets. The grooves of the barrel may also scrape the surface of the bullet to create marks on the 'lands' of the projectiles. They are usually present when the bullets are made of lead or when the bullet fired in somewhat over-sized or expand to fill the bore.

The leads (the tapered area between the chamber and the rifling of the barrel) sometimes scrape the bullets. The marks are called slippage marks.

The frequently utilised marks for the identification of the firearm are class characteristics and the striations engraved by the lands of the barrel. The groove scrapes are equally useful whenever they are present. The slippage marks are seldom utilised. The slippage marks should prove useful when the land and groove marks are not adequate. It is, however, difficult to prepare adequate specimen slippage marks for comparison purposes.

It is important to note that:—

a. The dirt (rust, soil, etc.) on the bullets or in the barrels affects the clarity of the marks. It mutilates or modifies the marks. Excessive rusting hinders/ prevent identification.
b. Lead bullets take up barrel marks easily. However, the marks are mutilated/destroyed with equal ease. The jacketed bullets retain the engraved/scraped marks on have better.
c. The bullets passing through the intermediate target (like wire gauze, glass, wood, etc.) may pick up scratches from the pierced material. They scratches may hinder the examination of the barrel marks.
d. The crimped edges of the cartridge case may mark the projectile coming out of the same. The marks are minute scratches parallel to the axis of the bullet. The marks do not interfere in the identification work.
e. Bullet passing through a bulged barrel may be engraved with the overlapping duplicate set of marks because the bullets jump through the bulge. The duplication hinders the evaluation of the marks.
f. A bullet fired from a revolver sometimes carries slippage (or shaving) marks because the projectile sometimes jump the gap between the wheel and the chamber due to imperfect their alignment. In the process, the edges of the barrel at the breech end shave or scratch the bullet. Ordinarily, the shaving does not obstruct identification. Sometimes they may provide identification data when the rifling marks are not clear due to imperfect imprint or mutilation of the marks.

1.5 Identification Basis of the Buckshots

The linkage of buckshots shots is of a great importance in forensic ballistics, especially in India where the shotgun is the main crime firearm because of easy availability of the firearm/ammunition and their improvisation.

The barrel surface of the firearm scratches its marks on buckshots passing through the barrel as in bullets. The creation of test exhibits, however, follows a different route.

The identification of marks on fired buckshot is possible because:—

(1) The projectile charge of a shotgun cartridge, ordinarily, moves in the form of a compact cylinder during their passage through the barrel. If there is no internal movement of the pellets/buckshots, only one segment of the barrel scratches the telltale marks from the chamber end to the muzzle end. This segment can be compared to a straight untwisted land, which marks the bullets in a rifled firearm.

(2) The scratched marks on the buckshots are the sum-total of the marks produced by this segment from the chamber end to the muzzle end. Even if there is some turning movement of the projectile (buckshot) inside the barrel, the extent is practically insignificant. The major part of the identifying marks will come from the barrel portion, near the muzzle end. These marks will always be available for the *inter se* comparison.

(3) If we can create marks from the whole barrel surface on a sample projectile, it would be possible to identify the marks of the particular segment, which leaves the marks on the buckshot in respect of the barrel/firearm. This is exactly what is done. The marks from the whole surface of the barrel are obtained on a tightly fitting slug by pushing it through the barrel. The marks on the buckshot and the test projectile are compared in the usual way.[1]

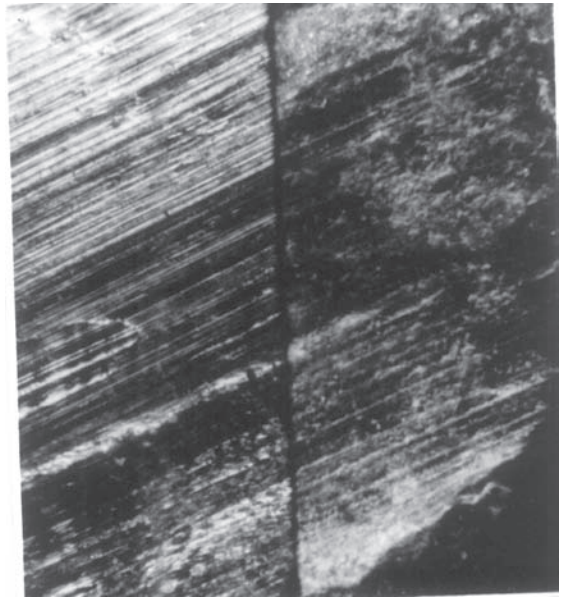


Fig. XI-9

Striations found on the buckshot correspond to those on the test slug showing a common source.

1. Supreme Court of India has accepted the identification of shotgun - projectile linkage in *M.P.* v. *Paltan Mallah*, 2005 Cr LJ 918 (SC).

2. TEXT EXHIBITS

The linkage/de-linkage of the fired ammunition seized from the scene (or taken out from the body/clothes of the victim) is done by comparing it with similar test exhibits prepared from the suspected firearm and corresponding ammunition. Ordinarily, one or more test cartridges are fired for this purpose. In the high-grade firearms, the relevant surfaces are so processed that they may not imprint sufficiently clear profiles. A number of cartridges are fired from such firearm to get acceptable test exhibits.

The number of test cartridges fired is not important. The limiting factor is the clarity of the marks. If the first test cartridge/bullet has clear marks, a second test cartridge/bullet is unnecessary.

Formerly, a number of test cartridges were fired and the imprinted marks studied *inter se* to establish the **thumbprint** of firearm. It is no longer practised. All concerned accept individuality of a firearm's thumbprint.

The ammunition of the same make and batch is used for the test purposes whenever possible. It is convenient, but neither necessary nor always possible.

Sometimes a culprit destroys firearm. Consequently, there is no firearm for test firing. The previously fired ammunition, if recovered, from him/his residence/previous owner can be used for comparison. It links the criminal with the crime as firmly as the recovery of the firearm itself would have done. It is also called **'No-gun'** work.

It is often dangerous to fire a fully loaded cartridge from a defective, damaged or an improvised firearm. Is such cases, the charge of the cartridge is reduced, before it is test fired. For example, when a test shell is required, the projectile charge is removed. Alternatively, the firearm is loaded, fixed in a vice, cocked and fired by pulling the trigger with a string attached.

The firing of the test cartridges with a full load is sometimes necessary to study the breech face, chamber and extractor marks.

A suspected firearm may not be fire-worthy. Its hammer or trigger may be out of order. In some such cases, the test cartridges may be fired by hitting the hammer with a rod or an ordinary hammer. The projectile charge is, ordinarily, removed before test firing.

In some rare cases, firearms are received which cannot be used for a test firing at all. In such cases, casts of the relevant surfaces of the firearm are prepared. The casts provide the test marks for the comparison.

A large number of materials have been used for preparing the cast. A flattened smooth lead piece is pressed with adequate pressure, or struck against the relevant surface with some force. It picks up the marks adequately. Silicon rubber and some other materials are also used.

In some cases, the direct comparison of the marks on the crime exhibit with the marks producing surface of the firearm (*e.g.*, breech face) may also be possible. It would involve comparison of the negative and the positive profiles. It needs some explaining to the judge and the counsels.

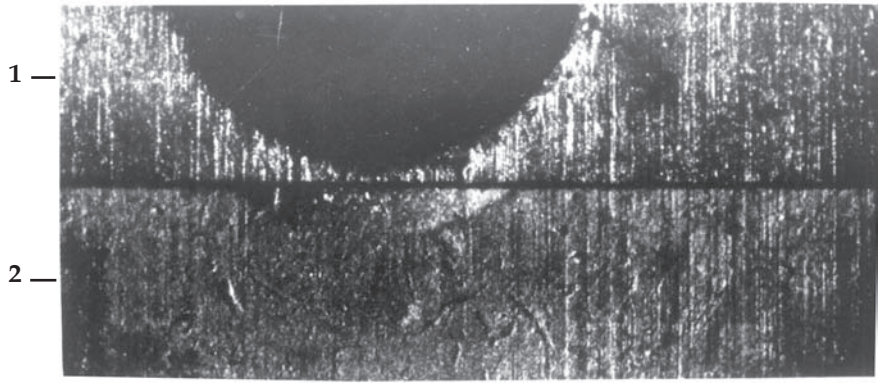


Fig. XI-10

If the firearm is too damaged to fire the cartridge, direct comparison of the breech marks with the breech face is also possible

(1) Breech face.

(2) Breech face marks on the incriminating fired cartridge.

1. Test Bullets/Projectiles

A bullet recovery box is filled with a variety of materials such as rags/saw dust/soap/paraffin/ice/cotton for test firing to obtain test bullets without mutilation. The author has found cotton is quite adequate. Most of the experts, in India, use cotton-filled bullet recovery box to obtain test bullets.

The bullet, due to the spin, forms a ball of cotton around itself when it passes through cotton in the box. The cotton ball protects the marks from mutilation and slows down the projectile because of the increased cross-sectional area. The bullet stops in the box.

Rags and sawdust may contain sand and gritty matter, which can modify the original marks or introduce additional new marks. Paraffin, soap and ice are also not so suitable. The bullets deflect in the media and the recovery is troublesome.

Water drum are also popular abroad for bullet recovery firing. They are indispensable for the recovery of test projectiles of shotgun ammunition. They are also used frequently to get test bullets from pistols/revolvers.

The rifles, firing high velocity projectiles, the defective/improvised/damaged firearms offer some difficulties.

a. With the high velocity ammunition there is danger of the bullet getting deflected and piercing the box. The emerged bullet may injure some person. It is, therefore, advisable to take out part of the powder charge (one half to two thirds). The reduction in powder charge is also advisable in the case of the other problematic firearms.

b. When it is not possible to fire test bullets at all, the test exhibit is obtained by pushing a tightly fitting projectile (or slug) through the barrel of the firearm. The projectiles of the correct diameter, pushed through the barrel give clear and reliable results.

c. Mathews has suggested that the test bullets should be obtained by firing the fully loaded cartridges whenever possible and with the reduced powder charge when one must. The test firing of the cartridges with full loads is unavoidable sometimes.

It is always desirable to use corresponding ammunition for test. If the crime bullet is jacketed, test bullet should also be jacketed. Lead crime bullets needs lead test bullets.

In a case of dacoity and murder, the firearm was so damaged that no test cartridge could be fired. The author extracted a bullet from the live cartridge and pushed it through the barrel. The pushed bullet was used for comparison purposes. (CH)

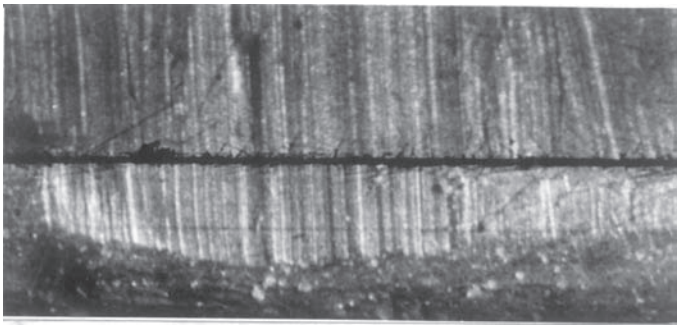


Fig. XI-11

Comparison of striation marks on an incriminating fired bullet with the one 'pushed through' the barrel, provided an adequate match. The pistol had been damaged after the occurrence.

2. Test Marks from Smooth Bores

The basic requirement of a test projectile for the evaluation and comparison of marks on fired buckshot, as already seen, is that the projectile should carry marks from the whole segment of the surface of the barrel. This is achieved by pushing a tight fitting slug made of lead, about two centimeters (2 cm long), through the barrel, without angular motion. The slug picks up the marks from the bore surface of the barrel. Thus, the slug carries all the marks, including those scratched on the crime buckshot in the firing.

The slugs of the appropriate sizes are prepared by pouring molten lead in a specially improvised mould or in the tubular portion of a cartridge case of the required diameter. The molten lead on solidification provides the slug for test purposes. Its surface may have to be smoothened in some cases.

The pellets and buckshots for test purposes are obtained by firing cartridges in water drums with false conical bottoms. The shots settle down at the bottom, from where they are recovered.

3. Cleaning

The bullets and the cartridges are cleaned before they are examined and compared. Dust and dirt is removed with a cotton-wool swab. The greasy surface is cleaned with petrol or other organic liquid. Dilute acetic acid and dilute hydrochloric acid are used to clean dull surfaces.

3. EXAMINATION

3.1 Visual Examination

Visual examination of a cartridge case gives an idea about the positions and the sizes of the firing pin, the breech face, the extractor, the ejector and the chamber marks. Sometimes there may be gross characteristic indentations, which permit identification/elimination of a suspected firearm. The visual examination often saves a lot of time.

Visual examination of bullets gives an idea about their calibre, the numbers of lands and grooves, their depth, width and direction. Some firearms are easily eliminated by this examination. Positive identifications of bullets, however, usually require instrumental evaluations.

The visual examination is carried out with ordinary light, allowed to fall at various angles. Hand magnifier is useful and improves the visual examination.

3.2 Stereomicroscopy

Stereomicroscopy is based upon the simple principle that the shape and structure of any article or surface can be perceived better with two eyes, in a natural way, rather than with one eye only. With an ordinary microscope, when there is one objective a flat image of the object is formed. There is no perception of depth of the field. A stereomicroscope overcomes the lacuna.

There are two objectives in a stereomicroscope. Two separate images are formed. The positions of the objectives are so arranged that the images formed overlap to the same extent to which the images formed by the lenses of the eyes overlap. The effect is the three dimensional image, as is the image seen by the eyes. The perception of depth is better. Consequently, the nooks and corners on the surfaces can be appreciated better. It gives a life-like picture of the marks. The stereoscopic effect cannot be achieved at very high magnifications. The highest useful magnification limit is about 100 X though magnifications up to 150 X are also utilised.

The stereo-photographs of the crime and the test exhibits in the firearm work have not become popular because they need special device to view and appraise them. Besides, the cost, the time and the effort needed in the process is not commensurate with the advantages obtained. Further, the production of photographs in the courts is becoming rarer. The exemption from personal appearance of the experts, vide section 293 of the Cr. P.C., 1973, has further reduced the use of photographs.

The stereomicroscopic examination of the bullets is useful for the determination of their class characteristics. They facilitate the elimination of the weapons of the other makes and models. The examination also facilitates the comparison work. It gives the idea as to what to look and where, in the comparison microscope.

The stereomicroscopic examination of the cartridge cases, especially of the firing pin indentations is far superior to most of the other techniques of examinations. In fact, only the Scanning Electron Microscopy is superior to stereomicroscopy. It is being used increasingly with great advantage.

3.3 Comparison Microscopy

A comparison microscope is indispensable in Forensic ballistics Laboratory. It gives quick, efficient and presentable link/de-linking evidence present on crime/test fired ammunition.

The principle on which the instrument works is simple. The comparison of the two sets of marks is facilitated if they are magnified to the same extent and brought in juxtaposition in the same plane, in an eyepiece or on a screen, simultaneously. A comparison microscope does the same.

Comparison microscope consists of two low power compound microscopes with matched optics. The images of the crime and the test exhibits formed in the two microscopes are brought together (side by side) where they are seen simultaneously.

The construction of a modern comparison microscopic is complex. The above optical system has been modified/improved beyond recognition. The optics of a comparison microscope has now a number of objectives and eyepieces, which can be brought into position and can be focussed just by the turn of a wheel or knob independently to give a number of combinations of the objectives and the eyepieces. Ordinarily, the manufacturers provide three pairs of objectives and three pairs of eyepieces. They cater for most of the needs of the firearm comparison microscopy. However, additional arrangements for incident light, phase contrast and fluorescent lights are also provided in the modern instruments.

The complete optical system is fixed on a vertical column. The microscope as a whole can thus, be moved up and down to cater for the different sizes of objects.

The instrument has been made more efficient and versatile by providing a number of additional gadgets.

The observations made in a microscope are recorded photographically. A photograph can convince the court better and more easily than verbal descriptions. Some courts, in India, want that the photographs should be produced, while giving evidence.

3.4 Comparison

The comparison microscope is the instrument of choice to study/compare/evaluate the crime and test exhibits in three ways:—

(1) Side by Side (juxtapose) Match

Here the relevant corresponding portions of the crime and the test exhibits are viewed side by side. The prominent marks are compared and the comparison establishes the match or the non-match. The marks in the matching positions are photographed.

The side-by-side match is useful for the non-striated impact marks from firing pin indentations, the breech face marks, the chamber marks etc. on the fired cartridges.

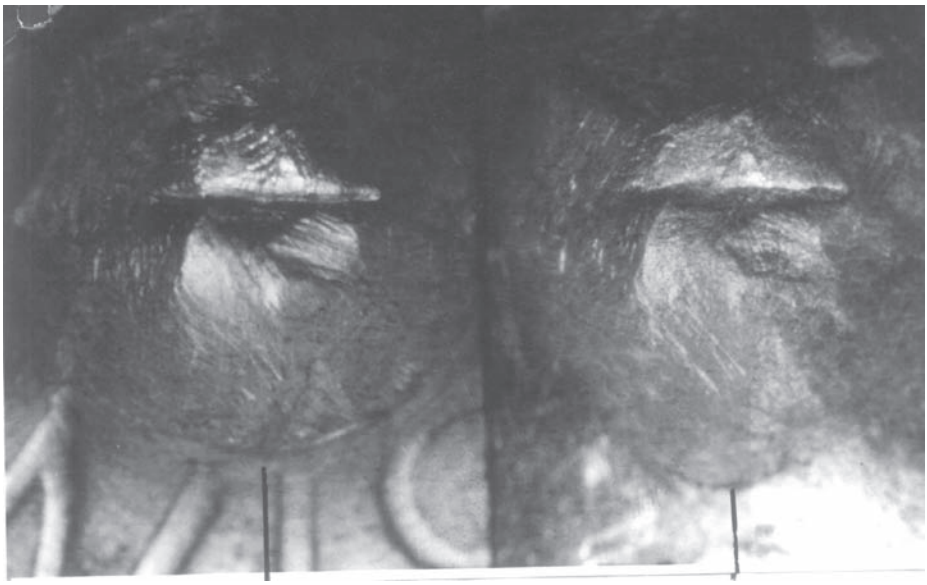


Fig. XI-12

A hat trick. Unusually artistic yet highly characteristic firing pin marks on the crime (C) and the test (T) cartridges identify the common source.

(2) Composite Match

This technique is applied, almost invariably, in the study of all the striated marks:

The firing pin scrapes on the bases of cartridges, the barrel marks on the bullets and buckshots and the scratches, if any, produced by the breech faces, the chambers, the extractors and the ejectors. The striated marks in the firing pin indentations, if present, are studied/compared/photographed by this process like other striated marks.

The corresponding positions of the crime and the test exhibits bearing the striated marks are brought together at the dividing line. The test or the crime exhibit is so manipulated that the striations on one side of the dividing line, show continuity across the dividing line, if the striated marks are from the same firearm.

Only a small portion, say one groove (or one land) marks are covered in the field of vision at one time. The marks on the whole periphery of the test and the crime projectiles are compared for the match by rotating the exhibits through 360°. The rotation has to be synchronized.

For the record, complete peripheral surface is photographed. For demonstration of match, however, photograph of one groove or land is often sufficient.

Software has come up, which helps to photograph the entire striations of the periphery in one plan strip.

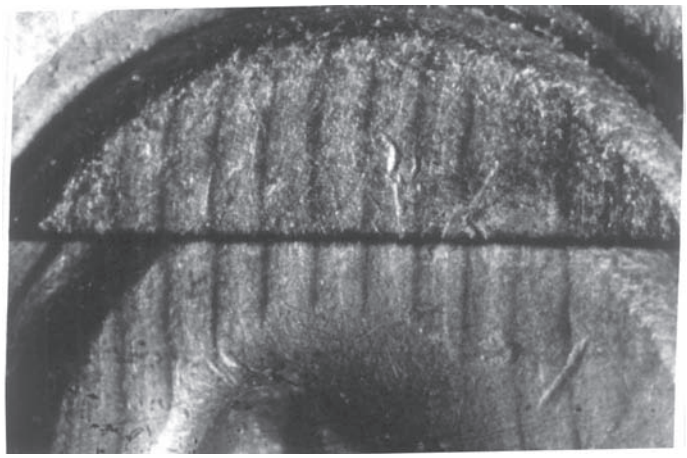


Fig. XI-13

Rare pattern of the striations of the breech face marks. They, alone, in some cases, can mislead as they can be common class characteristics. Or, they can be created or duplicated! The expert must look for finer striations' match for positive identifications.

(3) Superimposition Technique

Not all comparison microscopes permit superimpositions of the test and crime marks. The Leitz and the Projectina comparison microscopes are handy for this technique.

The images of the crime and the test exhibits are recorded side by side in half of the film ('C' and 'T'). On the lower half of the film, the superimposed photograph is obtained. The images here are so adjusted that the dividing line bisects the two images exactly, as in composite photograph. Once this is achieved, the dividing line (prism) is moved to one side slowly until the image in the field of view (on the screen) is only from one of the two exhibits (say, crime exhibit). The image is now photographed by exposing it for three-fourth the normal time of the exposure required. The exposure is stopped but the film is kept in the same position. The image of the other exhibit (test exhibit) is obtained on the screen by moving the dividing line (the prism) to the other side. This image is recorded on the same film over the first image, exposing it for three-fourth the normal exposure time.

This second image is found superimposed on the first one, if the adjustment of the exhibits and their images are proper and are not disturbed during the exposure process.

In actual practice, three exposures are given for the same set of crime and test exhibits. The first exposure records the match of the marks in the side-by-side position, the second and the third exposures record the images in the superimposed positions. One may use the same film or additional film for the superimposed pictures.

The technique is applicable for both the indentations and striated marks. The utility, however, is limited in the field of forensic ballistics as it is difficult for

a nonprofessional to comprehend the technique. Besides, when the dimensional differences in the marks on the test and crime exhibits are pronounced, the superimposed photographs may highly.

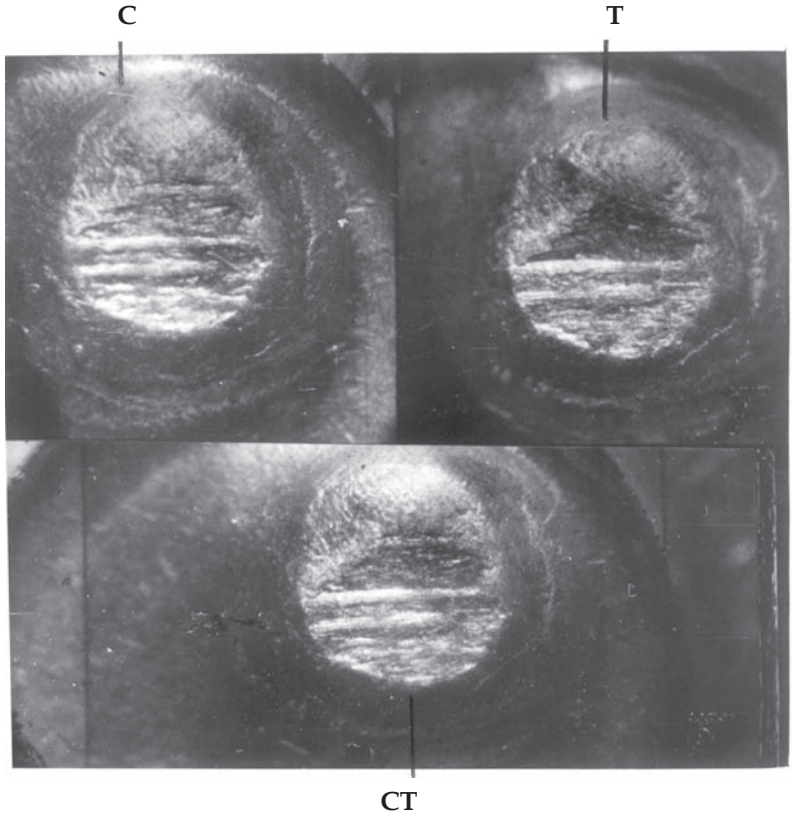


Fig. XI-14

A new superimposition technique, possible with some comparison microscopes. On the upper half of the film are side by side photographs of the crime (C) and test (T) marks (firing pin marks in this case). The superimposed exposure from each of the exhibits gives the photograph (CT) at the lower half of the same film.

(4) Computer Comparison

In USA, members of organized criminal gangs dealing in drugs, and other criminals, use standard factory-made firearm to kill and injure persons who happen to come in their way. If the same gang is responsible for a series of incidents, the serial nature of the incidents can be identified from the fired cartridge cases left at the scene or the bullets recovered from the victims or from the crime scenes. The criminal or the gang normally uses the same firearms in different cases, even in different police jurisdictions. The examination and comparison of the fired ammunition from these scenes can thus provide the linkages or de-linkages among different cases *inter se*, to indicate the serial nature of the occurrences. It facilitates the investigation of the cases.

In the initial stages, ballistics experts working in various laboratories carried out the examination and comparison of the fired ammunition seized from various crime scenes. It consumed a lot of time and effort on the part of the experts. The FBI and the Bureau of Firearms, Alcohol and Tobacco of USA, who are involved in the work, have harnessed the computer capability for automatic recording and comparison of the evidence on the fired cartridges and bullets. The evaluations and comparison can be carried out at many centres *via* the internet. The system is now known as NIBIN (National Integrated Ballistics Identification Network).

The system involves the following steps:

a. Digital Photographs of the marks on the newly seized fired cartridge case(s) or bullet(s) are taken at various data collection centres, known as Data Acquisition Station, Remote; using dedicated microscopes under similar conditions to those used for earlier images.
b. The digital photographic data is transferred to a computer.
c. The Computer compare the new data with the data already stored data. It gives a few hits.
d. Experts check the computer comparison given in the hits to confirm or reject the hits to establish the identity or non-identity of the marks on the newly collected fired ammunition.

(5) Comparison Camera

Mathews, one of the pioneers in forensic ballistics devised the comparison camera. It permits observations and photography of the marks on the crime and test exhibits directly, without involving a microscope.

The working principle of the camera is simple. This device combines two cameras with the matched optics and a common screen. A metal plate divides the screen into two parts for the images from the two cameras. The areas covered by the images on the screen can be varied by moving the position of the dividing plate. The position of the plate is so adjustable that the image formed by the two cameras can be cut and positioned at the desired point. The result is just like the arrangement of the dividing line in a comparison microscope.

The camera is of historical interest only. Nobody uses it for casework.

(6) Periphery Camera

The periphery camera is also called pantoscopic camera. It photographs the cylindrical surface of the crime bullet on one strip of the film. This is possible by synchronizing the angular speed of the bullet with the speed of the film movement.

The periphery photograph is useful where the examination of a crime bullet is to be carried out with other crime (or test) bullets at different places, far away from one another.

NIBIN system has made the gadget redundant. Computer software, *via* Internet is now used to compare marks on fired ammunition from different distant places.

(7) Scanning Electron Microscopy

The induction of scanning electron microscopy has profound effect in the entire field of Forensic Ballistics. It is becoming indispensable in the examination of marks on fired ammunition, GSR, etc. Its high resolution, (about 300 times more than that in the optical instruments), extremely high depth of focus, (three-dimensional effect) and almost unlimited magnifications make it an instrument of choice for the examination of all sorts of microscopic surface characteristics involved in Forensic Ballistics. Besides the coupling of the EDXA device with the instrument has increased its utility many times.

The working principle of the technique is simple. A beam of electrons is impinged on the surface. The extent, direction and intensity of secondary electrons emitted by the surface depend upon the surface structure of the surface in question and the original beam. The secondary electrons scattered by the surface are utilised to build up the image of the surface.

The scanning electron microscope requires high vacuum (2 x 10–5 mm. of mercury). In normal atmosphere, air absorbs the electrons. The exhibits, therefore, are placed in the vacuum. They must also be non-volatile and good conductors.

The area of the sample, which can be scanned, is about 8 cm square. The positioning is done by remote control.

The magnification range varies from 5 X to 100,000 X. In forensic ballistics, the magnifications beyond 1000 X are rarely needed. The resolution of the order of 200 A is achieved at 50,000 X.

The technique has been utilised to study the firing pin marks, the extractor marks, the breech face marks and the marks on bullets. The results reveal that the technique is superior to the existing techniques as it gives greater clarity through its three-dimensional image. The instrument is now being utilised routinely in forensic science laboratories for the evaluation, identification and comparison of the marks. It is being used increasingly to:

a. Identify the shooter *via* evaluations of the GSR on his hands
b. Ascertain the hand (left or right) which fired the shot
c. Identify the gunshot injuries, and
d. Determine the range of fire from GSR deposits.

Scanning Electron Microscope is used for qualitative as well as the quantitative analyses of GSR. High sensitivity and specificity of the technique/ instrument make it indispensable.

(8) Striagraphy

Striagraphy is the study of striations on a surface.

A very fine stylus, with a tip diameter less than 0.0002 cm. moves over the surface. The stylus moves up when it crosses a raised structure and it move down when it passes through a depression. This up/down movement of the

stylus tip gives the pattern of the topography of the striations on the surface. This up and down movement is amplified and recorded[1]. The gadget used for striagraphy is called a STRIAGRAPH.

Davis studied the striations found on bullets through striagraphy and compared the graphs obtained from text/crime exhibits to identify the common source.

The method does not offer any advantage over comparison microscopy. Rather it has many disadvantages. It is against this background that the method has remained a theoretical exercise in spite of the tall claim that it is the only tool to reveal the cross-sectional shape. The instrument, however, may be useful in research work.

(9) Cast

The preparation of cast of marks on firearms/fired ammunition is neither popular nor convenient. Perhaps, the lack of suitable materials to lift the fine details is the culprit. Besides, the lifted fine details need a comparison microscope for proper appraisal. In the majority of the firearm cases, therefore, where the marks can be compared directly under a comparison microscope, the lifting process is neither needed nor used. In certain cases, though few, the technique may be useful.

Davis has studied the process and evaluated the various lifting materials. Silicon rubber, mixed with aluminum powder, has been found to be a good medium to lift marks. The material, it is claimed, pick up the fine details. The addition of aluminum powder improves colour characteristics of the surface.

The casts prepared lifting tapes have been in use in the collection of the fingerprints since long. The lifting materials have been improved a lot, in recent years. The tapes should be useful in Forensic ballistics also.

(10) Macro-photography

A comparison microscope is extremely handy and efficient in the identification of the fired shells, the bullets and the pellets. In its absence, makeshift arrangement (Macro photography) may serve in some cases. The magnifications required in the work are frequently low, up to the range of 50 X, which can be achieved through macro photography. A bellow extension camera fitted with short focus lens(es). The results can be quite satisfactory in cartridge case examinations.

Overall, the technique is cumbersome and time consuming. It is no longer used. The technique, therefore, is of historical interest mainly.

1. An amplified tracer is used. It may have a mechanical or an optical amplification device.

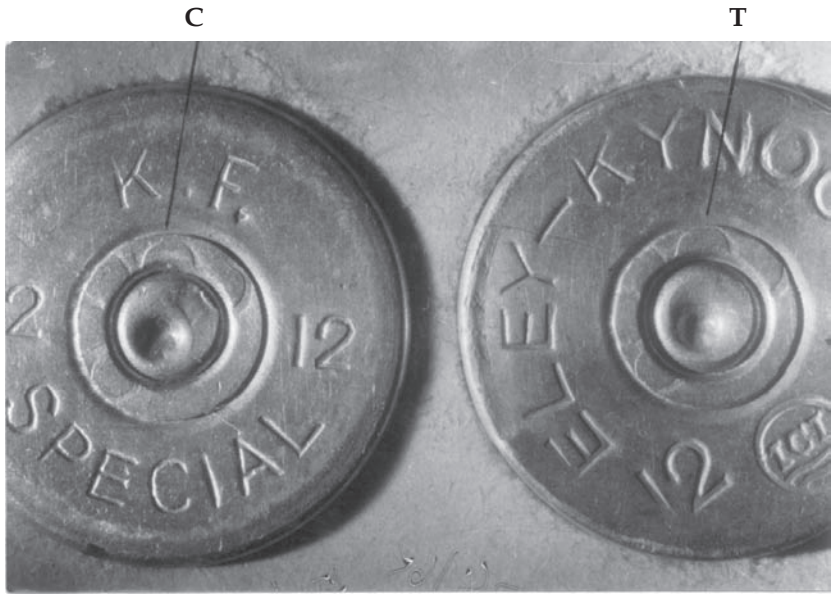


Fig. XI-15

Peculiar but characteristic breech face marks on the ring round the percussion cap. Circular arcs due to the holes on the breech face caused the various moon-phases like marks on the crime (C) and the test (T) cartridges. Macrophotography with a macro lens and camera sufficed to establish the identity of the common source of the crime and the test cartridges.

(11) NIBIN System (National Integrated Ballistics Identification Network)

NIBIN system is a conglomerate of the following sub-systems:

a. Data Acquisition System (DAS) Remotes

The system acquires new data from the cartridges and bullets with the help of a dedicated microscope. The data is digitized and stored in the computer. In USA, there are a number of DAS Remotes. All the gadgets used in data acquisition at all the DAS Remotes are alike.

b. Regional Servers

The data and images collected by the DAS Remotes are stored at the regional servers.

c. Match Points

Match Points are the centres where the comparison of the newly acquired data is done with the data the NIBIN has already stored in their computer. Computer gives hits, which are verified by the experts at the centre.

d. Rapid Brass Identification (RBI)

In certain police jurisdictions, DAS Remotes may not be available. NIBIN has organised RBI units to collect the data from such places.

e. Linkage

All the workstations and the RBI units are inter-linked through Internet.

NIBIN system is a sort of fingerprint bureau for the 'thumbprints' of firearms. The identifying data from all the licensed and factory-made firearms is generated and stored in the computers of the NIBIN before they are sold. This data is used to identify the offending firearm abused in a crime from the spent ammunition left at the shooting scene. Thus, the firearm (and the shooter) can be identified from the recorded data kept in the NIBIN.

The NIBIN system has many advantages:

(a) Comparison takes less time.

(b) Comparison and verification can be done at any designated Match Point place where the facilities for the work are installed.

(c) The hurdle presented by the deformation of bullets is taken care of by the NIBIN system.

The NIBIN system still has its problems:

(a) The criminals avoid registrations of sale/purchase of firearms. Many crime weapons escape NIBIN identification

(b) The identifying data of the firearms are altered soon after the purchase. The fired ammunition will, thus carry different marks that would not provide the match.

(c) The clarity of the marks may be inadequate for proper linkage in some cases. 3-dimensional imaging has overcome the lacunae largely.

NIBIN in India is not so helpful, if we see the current trends in abuse of firearms for crimes in the country:

(a) The system is useful in territories where the criminals use the same firearm in a series of crime. It does not happen routinely in India. It is rare that the same firearm is used a second time here.

(b) The author understands that one of the NIBIN systems, purchased and installed in one of the central government forensic institutions, has not been used in real crime situation. Its limited use is for the training of the staff and for research.

(c) The firearms used in crimes in India are usually smuggled firearms or improvised firearms. They have no record with the arms dealers.

NIBIN is however essential as a research tool and as part of automation. One system in one of the laboratories should be sufficient until such times that repeated abuse of a firearm becomes common.

Some other countries have also come up with systems similar to NIBIN, notably:

1. **Russia**. The systems are named ARSENAL and TAIS.
2. **France**. The system is called SIBLE.
3. **Turkey**. The device is BALISTIKA.
4. **Australia**. The equipment is known as FIREBALL.

The technology appears to be attractive. However, the practical utility in most of the countries is limited.

TRACE ELEMENTAL PROFILE

SYNOPSIS

1. **GENERAL**
2. **IMPORTANCE**
   - 2.1 Abuse of Shotgun
   - 2.2 Muzzleloaders
   - 2.3 Improvised Firearms
   - 2.4 Rifles
   - 2.5 Mutilated Bullets
   - 2.6 Bullets Fired through Higher Caliber Barrels
   - 2.7 Entrance Holes
3. **TOOLS & TECHNIQUES**
   - 3.1 Neutron Activation Analysis (NAA)
   - 3.2 Atomic Absorption Spectroscopy (AAS)
   - 3.3 Emission Spectrography
   - 3.4 Inductively Coupled Plasma Technique
   - 3.5 Miscellaneous

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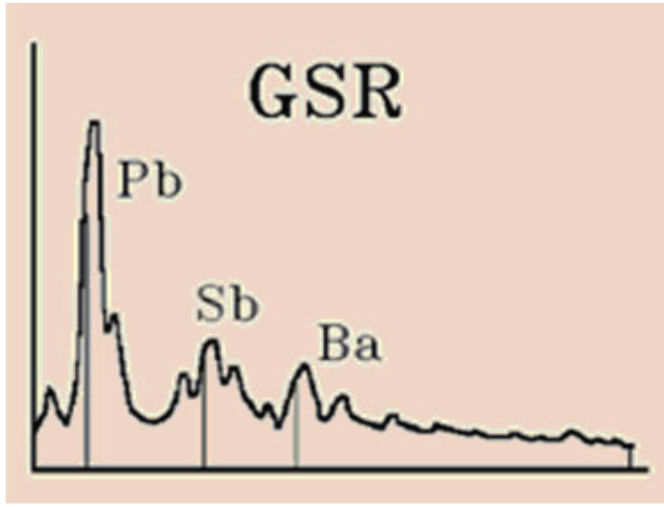
TRACE ELEMENTAL PROFILE



Trace elemental profile identifying GSR

1. GENERAL

Trace elemental profile of a substance is the data of trace elements, usually of metals, which is unique to that substance. The data relates to the nature of the element, the number of elements and their quantities. These adventitious elements are present in traces only in that substance. Such chance elements do not add to the quality of the substance. They are, in fact, impurities, which remain in spite of efforts to eliminate them from the substance. They do not affect the properties of the main substance substantially.

Each substance contains a number of chance elements as impurities to provide its unique profile. Hence a part of the substance, if separated, can be linked to the original source by developing the trace elemental profiles of the two parts and comparing them *inter se*. Corresponding profiles indicate a common source. For example, a person who uses a muzzleloader makes his own projectiles from lead. He kills a prohibited game (a deer) in a sanctuary. The projectiles(s) recovered from the game can be linked to the block of lead found in the possession of the hunter through trace elemental profiles of the lead from the two sources; thus linking him with the killing.

Trace elemental profiles are different for different substances. They can be compared (roughly) with the fingerprint profile of a person. The ridge characteristics, their positions and nature fix the fingerprint profile. Likewise, the nature of the elements, their number and their quantities are the identifying characteristics for the substance. They discriminate the substance from even from similar other substances; acting like ridge characteristics, to identify/ individualise the entity.

The presence of trace elements as impurities, in a substance, is inherent due to the processes through which it comes into existence. Previously the tools and techniques did not exist which could identify and quantify the elements present only in traces: micro-, nano- and Pico-grams, or even in lesser amounts. Now analytical tools and techniques have crossed all physical barriers. Even the tiniest amount of a material can be analysed to obtain its trace elemental profile.

2. IMPORTANCE

Trace elemental profiling is useful in the identification of a clue material *vis-a-vis* its source in many a crime situation, including those in Forensic Ballistics. A criminal invariably exchanges substances/traces on contact with any person or object. Thus, he may pick up traces like dust, dirt, soil, fibres, paint blood, semen. If he fired through a glass pane from close range, he is likely to carry glass pieces from the scene. In short, he exchanges traces with the scene, with the victim, with the weapon of offence (firearm), the vehicle he has used or even from the route(s) he has used in the commission of the crime. Thus, there are many situations in forensics where trace evidence can link the criminal with the crime, the scene, the other paraphernalia involved in the commission of crime.

The trace elemental profiles play a significant role in linking the criminal with the crime, in certain situations in Forensic Ballistics. In fact, they are indispensable in some cases:

In a case of murder, the culprit acted clever. He sawed off his unlicensed gun to hide it on his person while taking it to the scene of offence. He murdered the person and then placed the gun in the victim's hand after wiping off his fingerprints from the gun, to simulate suicide. He left the scene without being spotted.

Later, the police arrived at the scene and preliminary examination led them to think that it was a case of suicide. Then the investigators noticed that the barrel was freshly cut. Where is cut piece of the cut barrel?

They searched for the sawed off end an also for a hacksaw. They could not find them. The fresh cut had created a strong suspicion that perhaps another person was involved in the shooting and he had shortened the barrel to make it easy to conceal the weapon on his person. The absence of the barrel end and the hacksaw on the victim's premises strengthened their suspicion/belief.

The case was registered as murder and a search was started for the culprit. A hacksaw was found at the premises of one of the suspects, but no barrel end. The investigating officer found some sparkling particles lodged in the teeth of the hacksaw. They might link the hacksaw with the gun found at the scene of murder. Both the hacksaw and the gun were sent to the departmental Forensic laboratory.

Trace elemental profiling of the particles on the hacksaw and of the barrel metal were developed and compared. The profiles matched and thus linked culprit with the crime. (CH)

Trace elemental profiling has become an important technique in Forensic Ballistics.

2.1 Abuse of Shotgun

The shotgun/improvised shotgun/katta[1]are the most frequently abused firearms to commit crime, in India. They, usually, are not automatic or semi-automatic. They do not eject cartridge case(s) at the scene of occurrence. Further, In India[2], the shotgun cartridges normally available do not have projectiles like balls/buckshots, which can pick up striation marks from the barrel. They usually contain small-sized pellet charge, which do not register identifiable barrel striations. Thus, the investigator often is deprived of the linking evidence of cartridge cases/bullets.

Likewise, the ball or buckshot fired from a shotgun may not pick up identifiable striations, inhibiting the linkage of the ammunition with the firearm.

However, in these situations, the projectile recovered from the victim/scene can be linked to the culprit through similar ammunition recovered from the suspect. Trace elemental profiles are developed for the materials from the two sources (projectiles recovered from the body of the victim and ammunition seized from the suspect). If the profiles correspond, the suspect is linked to the crime.

2.2 Muzzleloaders

Muzzle-loading guns are used in some parts of India. They are cheap; the ammunition (black powder, homemade projectiles, etc.) used in them is also cheap. Further, obtaining a license for a muzzleloader is also comparatively easy. Some people keep and use even unlicensed muzzleloaders.

Muzzleloaders are used in crimes sometimes. There are no fired cartridge cases, nor are there well-marked projectiles to link the criminal with the crime. The materials left at the crime scene or with the victim are projectiles or their fragments. Sometimes GSR and wadding material are also found. The projectiles are the main evidentiary clues.

The homemade projectiles used in the muzzleloaders are usually from the cheapest lead that the shooter can get. These projectiles contain a number of impurities, which provide excellent trace elemental profiles. Comparison of these profiles with the source lead links (or de-links) the culprit with the crime. In the absence of bullet and fired cartridge case evidence, trace elemental profiles assume great importance to pin the guilt on to the culprit.

Some decades ago, a culprit used a factory made ball as the projectile in his muzzle-loading gun for murder. The lead ball extracted from the body corresponded in

1. An improvised shotgun with short barrel.
2. Indian Ordnance Factories produce 12 bore cartridges of BB and numbers 1 to 9 sizes only.

weight and dimensions to the ball projectile recovered from the suspect. Both crime and test ball ammunition contained lead and antimony.

The author found a stamp-like mark on it of the crime ball. The standard unused balls did not carry corresponding marks. It transpired that the mark could be from the ramrod of the suspect's firearm. The head of the ramrod was pressed with force on a test ball. Comparison of the marks on the crime and test balls revealed the common source. (CH)

2.3 Improvised Firearms

Due to a strict firearm licensing policy, an ordinary criminal does not get a license for a standard firearm. He, therefore, goes in for illegal improvised firearms, which are easily available in India.

Improvised firearms are used to commit crimes on a large scale, in India. These firearms are not made to any standard specification. Most of them are crude and dangerous – even to the user. The bore of the barrels is large. The projectiles do not fill the bore and therefore, do not mark them with identifiable striations. The improvised firearm is likely to have a weak breech mechanism and defective chamber. The cartridge often bursts, which may hinder the linkage of the cartridge case with the firearm in some cases. Trace elemental profiles of the crime/test projectiles link the criminal with the crime.

The improvised firearms have usually barrels with rough bore carrying protrusions. Such barrels scrape the projectiles fired through them extensively. Comparison of trace elemental profiles of the scraped metal and of the projectiles from the victim, or from the scene, can link or delink a suspected firearm with the crime.

If the cartridge has burst in the process of firing, its tiny fragments should be available at the scene, and in or on the firearm, in most of the cases. They can interlink the scene and the firearm through comparison of the trace elemental profiles of the fragments recovered from the two sources.

In an interesting case, a murderer used an improvised firearm to kill his victim. He left the firearm at the scene. When the police examined the scene they found that the firearm had burst and the cartridge, a 12-bore shotgun cartridge, was shattered. When checking up the possible suspects, they found one who had a recent injury on the hand and a small injury on his face. Could these injuries be due to the bursting of the cartridge? They checked the clothes of the suspect. They could locate some tiny metallic particles on his clothes. The rest was routine. Trace elemental profiles of the relevant clues linked the suspect with the murder. (CH)

2.4 Rifles

Most of the rifles, especially the service and sporting rifles, fire high velocity bullets. Most of them expand and fragment on hitting the target. Often the jacket bearing the rifling marks is lost or so mutilated that the striations thereon cannot be used to identify the rifle. In such circumstances only fragments of the core or jacket (or both) of the bullet are found in the body of the victim or at the scene.

Bullets with medium velocity may also fragment if they hit a hard target, like bones or metallic objects. In such cases, only their fragments may be available as evidence.

Fragments of bullets usually do not provide evidence to link them with the firearm *via* striations. Trace elemental profiles of the relevant entities, however, may provide the linkage. The ammunition has to be of the same make/batch.

2.5 Mutilated Bullets

When a bullet with high, medium or even low speed strikes a hard target, mutilation of the bullet, especially of lead bullets, is common. The extensive deformation may inhibit the evaluation/comparison of the striations. Trace elemental profiling of the crime bullet and of the corresponding seized bullets (ammunition) is the only alternative.

2.6 Bullets Fired through Higher Caliber Barrels

If a bullet is fired from a firearm of a caliber larger than that of the bullet, it does not pick up marks from the barrel, thus, eliminating striation match linkage. The trace elemental profiling still helps.

2.7 Entrance Holes

A bullet passing through a target is scraped and metal deposit takes place around the entrance hole. Likewise, a ricocheting bullet may leave some metallic scrape at the site of the ricochet. The traces left in the scrapes may connect the victim and the culprit *inter se* through trace elemental profiles.

3. TOOLS & TECHNIQUES

Trace elemental analysis is based on the following premises:

1. The mass of the metal, which is involved to give fragments of the projectiles, cartridge cases and other metallic fragments, is homogeneous. In fact, it is not so, both theoretically and practically. There are variations but they are within limits. The variations are taken into consideration and threshold values are determined statistically. The quantities of trace elements vary even when the lead for analysis is taken from the same bulk source. These threshold values have are taken into consideration for fixing the correspondence or non-correspondence of the profiles of the two samples.
2. The authenticity, integrity and identity of the samples analysed is without a shred of doubt.
3. The analytical fraternity use and accept the analytical technique employed.
4. The limitations of the techniques are known and have been taken into consideration.

The tools and techniques in trace elemental analysis have to be highly sensitive, specific and efficient.

The traditional wet chemical analysis techniques for trace elemental analysis are inadequate as the quantities of the relevant elements are extremely small/

impure/masked by other elements. Some spot colour test could detect some elements in small quantities but quantitative estimates were beyond reach.

During the past few decades, instrumental methods have come up. They have changed the scenario. They have crossed all physical barriers.

The following instrumental techniques have come up which provide the necessary data.

3.1 Neutron Activation Analysis (NAA)

Neutron Activation Analysis is a highly sensitive and specific technique, the material to be analysed is exposed to neutron bombardment in an atomic reactor. The elements thus become radioactive. The radioactivity of the elements of interest is studied. It gives their identity and quantity, which help to create the trace elemental profile.

The NAA technique is non-destructive. However, quantitative analysis is cumbersome and time consuming.

NAA facilities are available in India. The Central Government has established a unit in the Bhaba Atomic Research Centre (BARC) in Mumbai. The unit is under the control of the Central Forensic Science Laboratory, Hyderabad, which in turn, is controlled by the Ministry of Home Affairs through the Directorate of Forensic Science. Forensic Science Laboratories from all over India can make use the analytical facilities at BARC.

3.2 Atomic Absorption Spectroscopy (AAS)

The Atomic Absorption Spectroscopy is comparatively simple in its functioning. It does not require costly or elaborate equipment. It is sensitive and gives reliable quantitative analytical results. The main disadvantage is that multiple elemental analysis is time consuming, as concentration of each element has to be determined separately.

The facilities for the technique are available in most of the laboratories in India.

3.3 Emission Spectrography

Emission Spectrography is one of the oldest techniques used for elemental analysis. In competent hands, it can give both qualitative and quantitative results. The detection of the elements is comparatively easy but the determination of quantities needs a lot of time. The instrument is available with most of the laboratories but it is not used frequently.

3.4 Inductively Coupled Plasma Technique

Inductively Coupled Plasma Optical Emission Spectroscopy (ICPOES) is a sensitive and specific technique. It requires about 50 mg of lead bullet material for analysis. It gives both qualitative and quantitative results of the various elements (arsenic, antimony, tin, copper, bismuth, silver and cadmium) which are used to build the trace elemental profile of the entity being analysed. The profile is compared with a similar profile developed from the lead bullet(s) seized from the suspect.

3.5 Miscellaneous

There are numerous other instruments used in trace elemental analysis. The analyst chooses the instrument according to his liking/experience. Some of them are:

1. X-Ray Fluorescence Apparatus.
2. ICP-MS (Inductively Coupled Plasma-Mass Spectrometry).
3. SEM (Scanning Electron Microscope), etc.

GUNSHOT RESIDUES

SYNOPSIS

1. IMPORTANCE
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- 2.1 Inorganic residues
- 2.2 Smokeless Powder GSR
- 2.3 Black Powder GSR
- 2.4 Primer GSR

3. GSR SOURCES
4. DETECTION
5. COLLECTION
- 5.1 Dry Methods
- 5.2 Wet Methods
- 5.3 Collection of Organic GSR
    1. Swabbing
    2. Tape Lifting
    3. Vacuum Lifting

6. EVALUATIONS
- 6.1 Visual Examination
- 6.2 Infra-Red Photography
- 6.3 Soft X-Rays Radiography
- 6.4 Dermal Nitrate Test
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- 6.6 Harrison and Gilroy's Test
- 6.7 Price's Spot Test
- 6.8 Griess Test
- 6.9 Neutron Activation Analysis (NAA)
- 6.10 Atomic Absorption Spectrometry (AAS)
- 6.11 X-Ray Fluorescence
- 6.12 Scanning Electron Microscopy (SEM)
- 6.13 Additional Notes

13

GUNSHOT RESIDUES

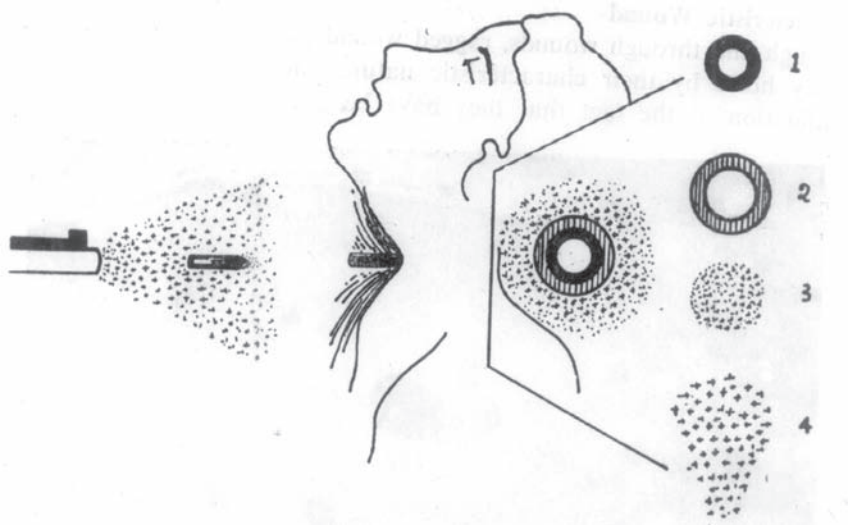


Fig. XIII-1

The mechanism of formation of firearm injuries and of formation of extraneous deposits.

The wound is characterised by:—

(1) Dirt ring due to the deposit of dirt (grease, graphite, soil etc.).

(2) Contusion ring formed by the impact on the edges, by the entering projectile.

(3) Smoke particles deposit around the wound—close range phenomena.

(4) Tattooing due to embedding of semi-burnt or unburnt powder particles—close range phenomena.

1. IMPORTANCE

The examination and the evaluation of the Gunshot Residues (GSR), in criminal situations, provide answer to many Forensic Ballistics problems including the following:—

1. Did a gunshot fire cause the given injury/hole/dent/scrape?

   This is an important evaluation in GSR studies. The following tests reveal the GSR deposits:

   (1) Autoradiography or radiography with soft X-rays reveals lead deposits.

   (2) Griess Test for nitrite particles indicates gunshot residues.

(3) Scanning Electron Microscopy identifies the bullet holes etc. Morphology of the particles and the elements (Pb, Ba, Sb)therein indicate GSR

2. Did the firearm/cartridge/projectile, in question, cause the injury?
3. Was the firearm/projectile/cartridge, in question, fired recently?
4. Did the suspect fire the shot(s) in the incident?
5. Did the victim shoot himself to commit suicide?
6. Was the shooting accidental?
7. When was the given gun/projectile/cartridge fired last?
8. Is the given wound/hole an entry or an exit wound?
9. Is the alleged 'suicide' genuine or fake?
10. What was the range of fire?

The latest developments in the evaluation of the GSR make it possible, through comparison, to link the GSR on the firearm/shooter/victim/target/fired cartridge or bullet holes on the garments or on intermediate targets/bullet marks or scrapes *inter se*. It is achieved through building/identifying the common trace Organic GSR profile.

The linkages are possible only if we have the basic analytical data to prove that the GSR from the given shot is unique and hence individualistic. This seems to be possible for the reasons:

a. A live cartridge contains more than 20 organic compounds. On firing, they (or their metabolites/fragments) are vapourised. They move along with the GSR and form part of the deposited GSR at the target. They stick to the target with greater tenacity.
b. Analytical techniques have crossed practically all physical barriers. They can identify and quantify organic compounds or their fragments even in small quantities (nano-/pico-/femto-grams)!

The identifying parameters have to be established. It needs plenty of experimental data. The scientists are at the work.

2. NATURE

Firearms/cartridges, on firing, produce residues made of many entities including chemicals from the primer, propellants (explosive), stabilizers, oxidizers, reducing agents, sensitizers, fuels, binders, bullets, bullet coating, bullet cores, metal jacket, cartridge cases, barrel, etc.;

Collectively, these materials are called GSR. Other names for GSR are Firearm Discharge Residues (FDR), Cartridge Powder Residues (CDR). The acronym GSR (Gun Shot Residues) has become popular for the residues. It has been used in the present discussion. The GSR consists of gases, vapors, smoke particles, semi-burnt, unburnt powder particles, and some metal particles from the firearm/primer/cartridge/projectile. The GSR escapes through any opening in the firearm. It settles on surfaces close the firearm-firing site.

GSRs are classified into two main categories:

a. Metallic/inorganic residues (GSR)
b. Organic Gun Shot Residues (OGSR)

2.1 Inorganic residues

Inorganic residues contain many elements. The most exploited elements are lead (Pb), barium (Ba) and antimony (Sb). Other elements are copper (Cu), zinc (Zn), sulfur (S), aluminum (Al), calcium (Ca), tin (Sn), silicon (Si), iron (Fe) and some others elements including strontium (Sr), titanium (Ti), copper (Cu) and potassium (K).

GSR also contains nitrite ions. They help to find the range of fire and the time of fire in some cases.

Some household items also contain some of these elements. However, morphology of the particle (globule like appearance in SEM photograph) and chemical analysis help in the identification of their GSR origin.

The cartridge case, bullet, bullet coating, and metal jacket also contain specific elements that can be detected. Virtually all cartridge cases are made of brass (70% copper and 30% zinc). A few have nickel coating. Primer cases are also made of Cu-Zn alloys. Bullet cores are most often lead and antimony. Some bullets have mild steel cores. Still others have both lead and steel masses. Bullet jackets are usually copper or brass (90% copper with 10% zinc), but in some, alloys of aluminum are also found. Some bullets have nickel, coating. Low velocity projectile (pellets/.22 bullets) are sometimes copper quoted.

Organic GSR comes from propellants and additives added to the primer/propellant charge to improve their keeping quality.

Common propellant in modern small arm ammunition is nitrocellulose. There are other ingredients also, in most of the propellant formulations. When nitrocellulose is the only the propellant, it is single base powder. If nitroglycerin is also mixed with nitrocellulose, it is double base powder. Nitroglycerin is usually in small amounts (1 to 40 %). Nitroglycerin in not used alone as propellant because of its high sensitivity and the high temperature it develops.

Additives include stabilisers, plasticisers, coolants, flash inhibitors and other components intended to improve the keeping quality/performance of the charge. Modern propellants may contain more than a score of organic compounds.

The important stabilizers are:

a. Diphenylamine (DPA),
b. Ethyl centralite (EC) and/or Methyl centralite (MC),
c. Nitrodiphenylamines (2NDPA and 4NDPA).

The gun, the cartridge and the range mainly determine the amount and pattern of the GSR deposits at the target or on the shooter or other entities close to the shooting site. Climatic conditions (wind/rain) influence the spread/deposit/recovery of GSR.

2.2 Smokeless Powder GSR

The detectable inorganic materials in the GSR of modern smokeless propellants are:—

1. Lead, from bullets and primers.
2. Barium, Antimony from the primers.
4. Copper, from the jacket.
5. Iron, from the barrels.
6. Carbon monoxide, absorbed in skin and flesh comes from the propellants, if fired from close range.
7. Nitrates, from the inorganic compounds and from propellants.
8. Nitrites, from propellants.
9. Zinc, from the jacket.
10. Nickel, from the nickel coating of the shells, in some cases.
11. Carbon particles.

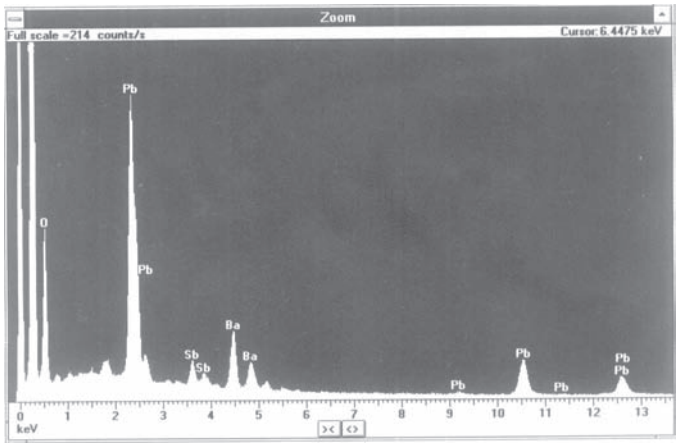


Fig. XIII-2

Lead, Antimony and Barium from the GSR through EDX, with SEM. The presence of the elements is a sure indication of the GSR.

The detectable organic components of the GSR include:

1. Nitrocellulose, the unburnt or the semi-burnt part of the main component of the propellant.
2. Nitroglycerine, the unburnt or semi-burnt part of the double base propellants, if used.
3. DPA (Diphenyl Amine), used as a stabiliser in all single base propellants. It constitutes roughly 1% of the propellant weight.
4. Ethyl centralite, used as stabiliser in double base powders. (~1% by weight of propellant).
5. Phthalates, used as plasticiser.
6. Glyceryl tri-accetate, used as plasticisers.

7. Nitroguanidine, used as plasticiser.
8. DNT (Di-nitro toluene), used as flash suppressant.
9. Bullet lubricants.
10. GSR constituents, from the barrel fouling of the previous firings; etc!

The smokeless propellants produce mostly gases. The gases are carbon monoxide, carbon dioxide, nitrogen, oxygen and water vapours. Some oxides of nitrogen are produced especially when the combustion is incomplete.

2.3 Black Powder GSR

Black powders on combustion produce 40 to 60 % gases. The rest are solids. The gaseous products are carbon monoxide, carbon dioxide, hydrogen sulphide, nitrogen, oxygen and water vapours. The solid residue consists of carbon, sulphates, carbonates, thiosulphates, sulphides and sulphites of potassium, unconsumed charcoal and sulphur.

The black powder is not used in modern ammunition. It is used in muzzleloaders and in homemade 12-bore cartridges. The evaluation of its residues is therefore, needed only in very few cases.

2.4 Primer GSR

The primer mixtures contain mercury fulminate[1], antimony sulphide, antimony oxide and potassium chlorate. In some primer mixtures, barium peroxide, barium nitrate or lead peroxide replaces potassium chlorate. Likewise, lead styphnate has replaced mercury fulminate in most of the primers. The primers contribute oxides of barium, antimony, copper, lead, potassium chloride and mercury to the GSR.

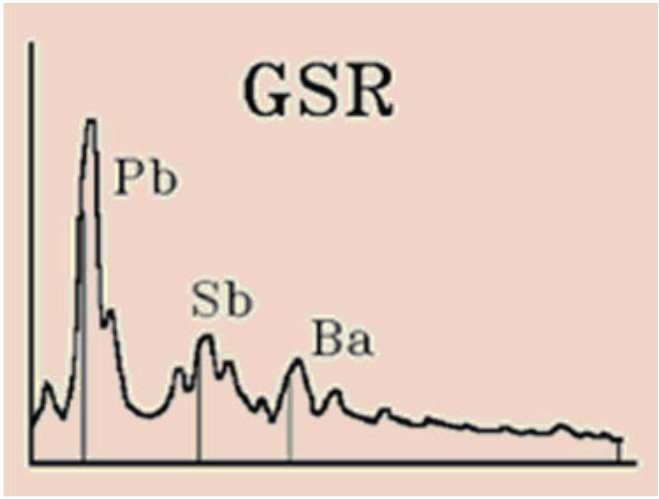


Fig. XIII-3

Trace of trio elements confirms its GSR origin

1. Replaced in most of the ammunition by lead styphnate in India, especially in INSAS ammunition.

The simultaneous presence of the GSR elemental trio: **lead, barium and antimony** fixes the identity of the entity as GSR. The SEM detects/identifies/quantifies the same in a particulate globule.

Scanning Electron Microscope (SEM) coupled with Energy-Dispersive X-ray spectrometry detector is the instrument of choice for GSR analysis. The detection of the three elements (Pb, Sb and Ba) in a particle, recovered from a suspect, fixes him as a shooter/participant/witness to the shooting incident. However, the particle analysed must not be due to secondary transfer.

GSR is complex/heterogeneous mixtures of combustion products in shooting. The inorganic particles are very durable and can even last indefinitely in a normal environment. However, physical interference, e.g., washing hands, can cause loss of the GSR particles. GSR particles have characteristic morphologies, mostly spherical but particles of irregular shapes are also formed. The globules have small diameter (< 5 μm). Their composition depends upon:—

1. The formulations of the propellants/primer mixtures.
2. The composition of the projectile/casings materials.
3. The barrel fouling scraped by the shot.

3. GSR SOURCES

The common sources for GSR in shooting cases are:

1. The hand(s), face and clothes of the shooter.
2. Persons near the shooter.

   The various articles around the shooter; the GSR particles are light in weight. They do not travel afar. They are deposited on the objects, which are close to the shooter/firearm at the time of fire.
3. The target: around the wound/holes of the projectile on the clothes, exposed skin, etc. of the victim, in close range firing.
4. On the furniture or bedding where the victim has been shot.
5. In the wound track, especially if the shot was fired from close range.
6. Around the exit wound (in rare cases).
7. The firearms—its outer surface and bore of the barrel.
8. The fired cartridge case.
9. The fired projectile(s).
10. The articles around/near the target.
11. The intermediate targets.
12. Surrounding air (Suspended particles in the air!).

The GSR particles disperse in the air being light particles. They continue to float in the air for some time. Ultimately, they settle on surfaces, which come in their contact.

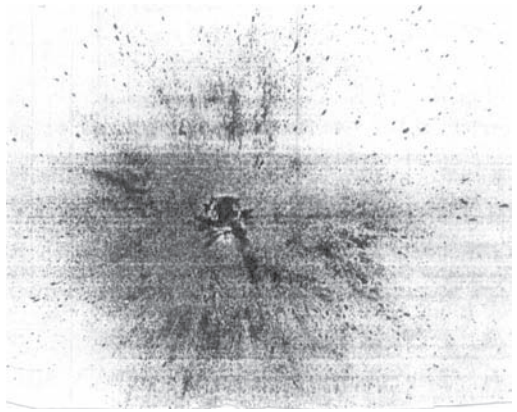


Fig. XIII-4

Back-spattered GSR on the back surface of an intermediate target placed close to the main target.

The range of spread of GSR varies. The environmental conditions affect the same.

4. DETECTION

The GSR is detected visually in many cases. Hand magnifiers and stereomicroscopes improve the visual examination. The visual examinations have limitations. The following techniques supplement detection:

1. Infra Red rays photography reveals GSR on coloured clothes.

X**-rays fluorescence** (micro) reveals lead/other metal particles present in the deposited GSR.

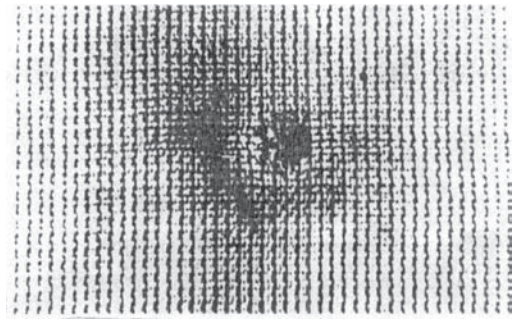


Fig. XIII-5

IR photography reveals

GSR on dark cloth, indicating close range fire.

2. Scanning Electron Microscope gives characteristic morphology of the particles and number of particles. EDX (an accessory of SEM) establishes the presence of lead, antimony, barium etc. to fix the identity of the entity as GSR.

3. Chemical methods.

The common chemical detection tests include:

a. Dermal Nitrate Test
b. Walker's Test
c. Spot test for lead.
d. Harrison and Gilroy's Test
e. Price spot test.
f. Griess test

The frequently utilised tests for detection are the Walker's test, the Griess test and spot tests.

5. COLLECTION

A number of methods are used to collect gunshot residues, including the following:—

5.1 Dry Methods

1. The method is to collect gunshot residues from the hands. Wax of suitable melting point is selected/melted/gently brushed over the hands to a thickness of 1 to 2 mm. The casts are peeled off on cooling. It picks up the GSR from the hand.
2. A cellulose acetate solution is applied to the site bearing the gunshot residues. It is peeled off after the solvent has evaporated. The cast picks up the gunshot residues.
3. A collodion solution is sprayed at the site bearing the powder marks. The film is reinforced with nylon fibres. The reinforced film, which picks up the powder residues, is peeled off, after the solvent has evaporated.
4. The site bearing the gunshot residues is pressed with an inert adhesive tape, or with an adhesive aluminum foil, repeatedly. The tape is kept in a vial with adhesive surface inside the vial, before and after the use. The tape is mounted on a specimen stub for examination. The method is becoming popular.

5.2 Wet Methods

1. A filter paper is moistened with dilute acetic acid. It is pressed against the spot suspected to bear gunshot residues. The filter paper picks up the GSR.
2. The site bearing the gunshot residues is swabbed with a clean cotton cloth piece or a cotton swab, moistened with dilute hydrochloric acid (10%) or with nitric acid (5%). The swab picks up GSR. The swabs from various parts of the hand are collected separately.
3. The hands are rinsed thoroughly in dilute nitric acid (50 ml of 1 molar nitric acid is used) placed in a plastic bag. The acid extracts the GSR. The solution thus obtained is freeze dried and tested in the laboratory.
4. The residues in the barrel are collected by washing the barrel with hot distilled water. The washings are tested for GSR composition.

5. A cellophane sheet, impregnated with acetic acid, is pressed against the site. It picks up lead.

5.3 Collection of Organic GSR

The evaluation of the organic GSR has acquired tremendous importance in recent times, because:

They settle on the surfaces in vapour form, with stronger adhesion. They are available for considerably longer period. The inorganic GSR remain on the body for about 6 hours, the organic GSR may remain for about 24 hours.

The organic compounds found in GSR are not common in household's materials. They therefore, if detected, are only from GSR.

The variety is large. More than 20 different compound are used in ammunition

The following are the important collection techniques:—

1. Swabbing

A small cotton wool ball, a clean cloth piece, or a filter paper is moistened with organic solvents (acetone, ether or alcohol) and the site is swabbed. The swabs are collected and processed in a Forensic Science Laboratory.

2. Tape Lifting

An inert tape of suitable width (2-3 cm) is taken and the site is taped. The tape is used as such in Scanning Electron Microscope or the GSR components are extracted and tested. The tape lifting is becoming popular for its convenience and application is all situations including lifting GSR from cadavers. The tape picks up both organic and inorganic constituents of GSR.

3. Vacuum Lifting

Vacuum lifting is especially useful to collect GSR from clothes. The material deposited on the filter disc is extracted with a suitable solvent for further processing.

6. EVALUATIONS

The identification of GSR is based on a combination of morphological and elemental composition criteria. The presence of lead, antimony and barium, in a single particle, has been observed in GSR only. It is considered unique for GSR. The particulate's specific shapes provide useful information to initiate chemical analysis: to differentiate GSR particles from occupational and environmental particles.

A lot of research is being carried out in recent times to evaluate GSR, particularly its organic components. Excellent techniques have come up to identify/quantify its constituents even in micro and nanogram quantities.

The evaluation of GSR follows the following modes:—

6.1 Visual Examination

If the firearm is discharged from a close range, the visual examination may reveal burning, blackening, tattooing, etc. Their presence indicates a gunshot injury/projectile hole or dent.

A hand magnifier, a stereo microscope and a strong light source improve the detection/identification.

6.2 Infra-Red Photography

If the bullet holes are on coloured clothes, the presence of gunshot residue is masked. Infrared photography reveals the gunshot residues in the IR photograph.

6.3 Soft X-Rays Radiography

The lead metal is opaque to X-rays. A soft X-ray radiograph of a hole, identify it as a gunshot fire hole if radio opaque deposit is seen around the hole.

6.4 Dermal Nitrate Test

Prior to 1950, Dermal Nitrate Test was used frequently to identify the shooter. The test is simple. The nitrates are picked up on a paraffin wax cast as described earlier. The picked-up residues on the cast are treated with diphenylamine dissolved in strong sulphuric acid. The appearance of blue colour spots indicates nitrates. They, in turn, indicate the presence of the GSR.

The dermal nitrate test in not specific for GSR. Some occupational/ environmental materials also give similar colour. The method is no longer used.

6.5 Walker's Test

Walker's Test is widely used even today. Its simplicity and greater specificity makes it a convenient test.

A de-sensitised glossy bromide paper is taken. It is treated with 2 naphthylamine 4:8-disulphonic acid (5%). The bromide paper is placed over a table with the treated surface upward. The cloth area bearing the gunshot residues is placed over the bromide paper. It is covered with a towel moistened with 20% acetic acid and the set up is pressed with a hot electric iron for about five to ten minutes. Dark red spots on the bromide paper indicate gunshot residues.

A modified version of the test is as under:—

> A piece of filter paper is moistened with acetic acid. It is pressed against the target surface. It picks up the gunshot residues. The filter paper is then sprayed with a solution of 2 naphthylamine sulphanilic acid and citric acid. The pink coloured specks indicate nitrite particles. They, in turn, indicate the gunshot residues.

The test is useful to:—

1. Identify the bullet entrance holes/wounds.
2. Determine the range of fire.
3. Ascertain whether a firearm, bullet, cartridge, etc. has been fired or not.
4. Estimate the approximate time of fire. The diminishing intensity of the colour formed is the indicator of the time elapsed.
5. Identify a shooter.

6.6 Harrison and Gilroy's Test

Harrison and Gilroy's Test determines the presence of lead, antimony and barium through spot test. The test gives good results involving revolver shooting.

The gunshot residues containing the metallic constituents are collected on a piece of cotton cloth (moistened with dilute (0.1 molar) hydrochloric acid as described earlier. The cloth is, then, tested as under:—

1. A dried piece of test cloth is treated with one drop of triphenyl methyl-arsonium iodide alcoholic solution (10%). The appearance of an orange ring, in about two minutes' time, indicates the presence of antimony.
2. The test cloth bearing the orange ring is dried and two drops of sodium rhodizonate solution (5%) are put in the centre of the ring. Red colour development, inside the ring, indicates lead, barium or both.
3. The test cloth is dried again. A drop of dilute hydrochloric acid (1: 20) is placed on the red spot developed in (2) above. If the colour changes to blue, lead is indicated. If the colour does not change, barium is indicated.

The test is useful to identify a shooter or a bullet hole. The test is, however, not popular. It gives unstable colours. The three elements interfere with one another. The results are qualitative only.

The test often fails in shootings with firearms other than revolvers.

6.7 Price's Spot Test

This technique involves the identification of lead through a standard spot test using, sodium rhodizonate solutions. The gunshot residues are collected from the hands on a piece of cloth moistened with 10% hydrochloric acid. The test does not offer any advantage over Harrison Gilroy's test.

6.8 Griess Test

In Griess Test, which is a colour text, Griess reagent react with GSR to produce rose colour. As nitrites are not common commodity in everyday life, the specificity of the test, for GSR is greater. Griess reagent consists of sulphanilic acid and á-naphthyl amine in acetic acid aqueous solution. The detection of free nitrite ions is based on the formation of diazonium ion from sulphanilic acid and nitrite. The diazonium ion couples with á-naphthyl amine to form an orange azo dye. There are many modifications of the test.

Griess Test involves the following steps:

1. Surface carrying GSR is sprayed with 10% sodium hydoxide solution. Alternatively, the GSR is picked up on an adhesive tape.
2. Whatman fitter paper is dipped in Griess reagent (3% sulphanilamide, 0.3% N-(1-naphthyl) ethylene diamide, dihydrochloride, both dissolved in 5% sulfuric acid).
3. The damp filter paper is placed on the GSR and lightly ironed for 30 seconds.

Rose colour spots appear on the filter paper. They indicate nitrite particles (GSR).

Griess Test is widely used for the identification of GSR. It is specific for nitrite particulars. It is also being used for determing shooting distance (Range).

6.9 Neutron Activation Analysis (NAA)

Neutron Activation Analysis gunshot residues detects the presence of antimony and barium. Neutrons, in a nuclear reactor, bombard the GSR. Antimony and barium capture one neutron each to give radioactive antimony ($Sb_{121} \rightarrow Sb_{122}$) and radioactive barium ($Ba_{138} \rightarrow Ba_{139}$).

The radioactive nuclides emit gamma rays. Evaluation of the energy and half-life help to identify and estimate the elements.

Neutron activation analysis is a highly sensitive technique. However, it is cumbersome:—

1. It needs a reactor for the neutron source, which are scarce.
2. It is time consuming.
3. It needs a lot of pre-and post-activation chemical treatment of the samples. For example, sodium and chloride ions from perspiration have to be eliminated for a proper estimation.
4. The technique is not suitable for analysis of lead, which is one of the most important metallic constituents of gunshot residues.

The NAA technique is useless for fieldwork. It may be useful for research.

The facility for Neutron Activation Analysis, in India, is available at Bhaba Atomic Research Centre in Bombay.

6.10 Atomic Absorption Spectrometry (AAS)

Atomic absorption spectrometry is an extremely sensitive and convenient technique for the evaluation of the gunshot residues. It can detect the elements in nanogram and picogram ranges.

Atomic absorption spectrometry works on a very simple principle. An element absorbs the radiation of the same wavelength as it emits when excited. The suspected element (in gunshot residues) is taken into an atomiser (a graphite tube or a Tantalum strip) and is excited by heating. The radiation from a discharge tube with the suspected metal electrodes is passed through the atomiser. The loss of intensity in radiation gives the measure of the quantity of the metal in question.

The technique is useful and popular for the examination of the gunshot residues. It is less costly, consumes less time and is applicable for lead estimations.

6.11 X-Ray Fluorescence

Another method of choice for the analysis of the gunshot residues is the use of the X-ray fluorescence. The technique has been extensively used to carry out both qualitative and quantitative elemental analysis of the residues. The comparative low price of the needed equipment, the simplicity of the technique

and of the operation, and efficient results make it a convenient method for GSR evaluations.

Autoradiography, photoluminescence, lead isotopy, emission spectroscopy and polarography have also been employed.

6.12 Scanning Electron Microscopy (SEM)

The hands of the suspected shooter are one of the areas that yield substantial amount of GSR. Other potential sources on the suspect are:

1. Clothing of the shooter, wherein clothing retains the GSR for a long time. They are often unnoticeable. They should be seized at the earliest, with minimum handling.
2. The face of the shooter is often sprayed with GSR. The quantity is less and may be invisible to the naked eye.
3. The hair of the shooter may also carry GSR. It should be collected through brushing/washing.

There are several techniques for the examination of GSR. However, Scanning Electron Microscope (SEM), coupled with an EDX (Energy Dispersive X-ray) analyzer is considered the best for elemental analysis of unique GSR trio elements (Pb, Sb and Ba).

The energy source of SEM shoots a beam of electrons directly on to the GSR particle on an adhesive stub. The primary electron beam interacts with the material. This process releases energy in the form of characteristic X-rays of the relevant elements.

The spectrum provides both qualitative/quantitative analyses. Computers have facilitated the location of the particle on the stub and the identification/quantization of the various elements through dedicated software.

6.13 Additional Notes

GSR is frequently utilised to find the range of fire from the presence of burning, singeing, blackening and tattooing, presence of nitrate or nitrite particles and the quantitative estimation of antimony, barium and lead.

Recently, experiments were done on an extensive scale in Germany; 700 shots were fired from various ranges and the quantity of lead was estimated. The data was fed into the computer and programmed. To find the range in a particular case, the quantity of lead found at the target is fed into the computer along with the data relating to the arm and ammunition involved. The range is read from the computer. The results are accurate if the parameters for the collection of the GSR data are correct.

Nitrite ions in smokeless powder GSR are proving handy. They are lifted with an adhesive tape and tested with Griess reagent or its modified version.

The determination of range is usually done through the determination of quantities of antimony, barium and lead. The quantities in the GSR are in micro/nano/pico grams. X-ray fluorescence/atomic absorption spectrometry/SEM are the most convenient techniques for the analysis.

A ring from the target cloth with an internal diameter of two centimetres and the external diameter of about four centimetres is cut. The area around the hole bearing the dirt (the wipe) ring is scrupulously avoided. The cloth ring thus obtained is ashed in an oven. The ash is dissolved in nitric acid. The appropriate (available) technique is employed for testing and estimating the elements.

The test cloth targets are handled similarly for sampling and the analysis is carried out in the same way. The computers are used to compare to find the range.

Gunshot residues penetrate the target cloth. The test shots for range determination, therefore, are made on the same/similar cloth target. Otherwise, the results may not be correct.

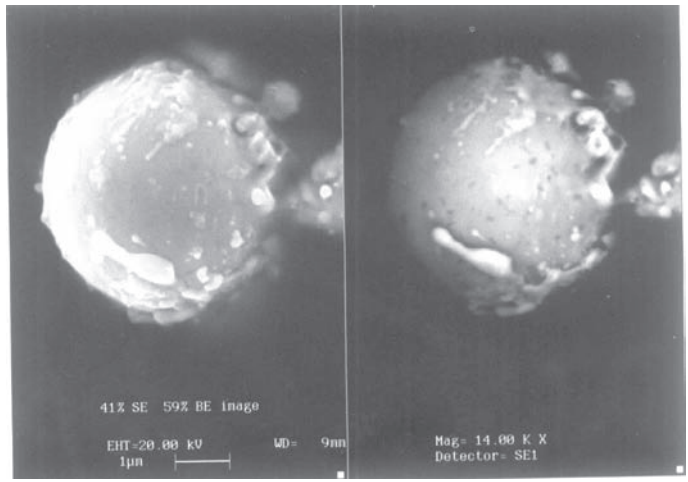


Fig. XIII-6

GSR (lead) particles through SEM.

SHOOTING RANGE

SYNOPSIS

1. IMPORTANCE

2. RANGE OF FIRE

2.1 Muzzle Pattern

2.2 Ejecta inside the Wound

2.3 Scorching

2.4 Gunshot Residues

2.5 Blackening

2.6 Tattooing

2.7 Metallic Residues

2.8 Wad Distribution

2.9 Pellet Pattern

2.10 Direction of Wound

2.11 Injuries

2.12 Marks

2.13 Various Ranges of a Firearm

14

SHOOTING RANGE

1. IMPORTANCE

The estimation of shooting distance (range of fire) is an important evaluation in Forensic Ballistics. It helps in ascertaining whether:

1. The given injury on the victim were inflicted from the alleged range.
2. The version of the shooter/victim/witnesses is correct.
3. The shooting is real or fake.
4. The encounter story is real or false.
5. The given incidence is accident/suicide/homicide/killing in self-defence.

Accurate estimates of the firing range are possible in quite a few cases. Thus, they provide useful and important information in the determination of sequence of events and help in the reconstruction of the incident. Status of the knowledge and the technology relating to various aspects is briefly discussed below.

2. RANGE OF FIRE

The determination of the range of fire is possible if proper photographs, sketches, description of the injuries, the suspected firearm and the ammunition similar to the one used in the commission of crime are available. Accurate estimate of the range can be made, if skin surroundings the wound (in death cases), in close range shots is sent for GSR analysis.

The visit to the scene or a video graph of the unaltered shooting incident helps.

The number of variables, which affect the range, is large. For example, in ammunition alone, the primers, powders, cartridge cases, projectiles and packing have profound effect. In primers, the hardness of the cup, the dimensions and the position of the flash holes, and the placement and nature of the primer composition are important. In propellants, the particle size, quantity, composition, shape, rate of burning, the space for expansion and other conditions affect the range. In wads, their stiffness, closing pressure and crimping are relevant. In projectiles their condition, weight, diameter, jacket and dimensional uniformity matter. In cartridge cases their cleanliness, hardness and corrosion, if present, affect the results in a similar way.

From the variables, it appears that it is futile to attempt the determination of the range of fire! However, it is not so. Given the same firearm and similar ammunition, a lot can be accomplished. The results cannot be duplicated

completely, but a close duplication can be achieved. The results are quite satisfactory for all practical purposes.

The following evaluations are helpful to determine the range of fire:—

2.1 Muzzle Pattern

When a firearm, pressed against the target, is discharged, the muzzle leaves its imprint on the target. The muzzle pattern, therefore, indicates a contact wound. The contact wounds are observed in suicide cases but they are also seen in some murder cases.

The muzzle pattern may also appear on a corpse if the muzzle of the gun is pressed against the corpse when fired.

Fig. XIV-1

Muzzle pattern (partial) indicates hard contact injury, in a murder case. The victims were travelling in car. The car was stopped and all the occupants were killed.

2.2 Ejecta inside the Wound

When the firearm is fired in contact or near contact position, the entire ejecta: projectiles, wads (if any), smoke, burnt, semi-burned or unburned powder particles and hot gases enter into the target. No burning, blackening or tattooing phenomena is observed around the entrance hole in many cases. Instead, the phenomena are observed inside the wound, if the inside tissues of the wound are carefully examined after incision at the site. In those cases where there is no space for the expansion of the gases inside (for example between the skull bone and the outer skin), the ejecta come out through the entrance hole and in the process often tear the skin around the entrance hole. A star-shaped wound, with everted edges, is formed. The wound appears like an exit hole. It happens in contact head injuries. Such injuries can also occur in some other hard parts of the body.

Fig. XIV-2

Explosive wound from contact shot.

2.3 Scorching

The scorching of the target is caused by the flame or by the hot gases of the combustion. It is a sure sign that a firearm has been fired from a close range. The hot gas can travel forward only to a limited distance, which varies from a few centimeters, in the case of pistols and revolvers, to a decimetre in the case of the shoulder firearms. Scorching range will depend upon the length of the barrel of the firearm and the quantity and age of the propellant and other constituents of the cartridge. The proper initiation and the burning rate of propellant in the firearm also affect. Tests for comparison are carried out with the same firearm on pigskin.

The 'hot' projectiles never cause burning. They do come in contact with the hot gases, at temperature around 2000°C. However, the time interval of contact of the projectiles with hot gases is so short that there is not much heat transfer. Likewise, the contact period of the skin is also too short (in microseconds) to cause burning. In addition, there is insufficient heat transfer to do so.

The scorching, burning, singeing and charring are taken as synonymous. They are often confused with blackening, dirt-ring and the contusion ring. They can be distinguished easily. The blackening and dirt ring can be removed by swabbing the surface with spirit. The charring remains. The burnt and contused skins have different microscopic structures. Microscopy, therefore, also helps to discriminate scorching from blackening/contusion. Besides contusion ring is regular in shape; charring has no regular shape.

In muzzleloader firearms, wadding may catch fire on coming out of the firearm. It may extend the burning range by scorching the target. It happens rarely.

2.4 Gunshot Residues[1]

Gunshot residues (GSR) on the targets have been extensively explored, in recent times, to find out the range of fire. The spread pattern and quantification of metallic residues and nitrite ions are giving encouraging results and the range of fire up to about one metre can be established with fair accuracy, with most of the firearms, from the evaluation of the GSR. The details of the procedures have been discussed in the previous chapter.[2]

2.5 Blackening

The blackening of the skin or target surface around the wound/hole is caused by the deposition of smoke particles of all types of propellants. It is a close range phenomenon. The intensity of the colour is maximum with black powder, less in semi-smokeless powder, and the least in smokeless powder, when fired from the same range and with equivalent quantities of powders used in the ammunition. The colour of the smoke deposit is more or less grey to black, depending upon the quantity of the smoke deposited and the nature of the powder used. It is difficult to predict the nature of the powder used by the visual examination of the smoke deposit alone. The deposit of volatilised lead enhances the intensity of the blackening a little, at shorter range. The smoke is formed due to incomplete burning of the powder charge, lubricants and sealants. It is propelled along with the projectile charge. Being light, it soon loses its velocity and is deposited on any material available in the path or disperses in the air.

If the same firearm and the ammunition of the same make and batch are used for test firing from various ranges, the amount of the GSR, corresponding to the amount in the crime situation, will indicate the range of fire in the crime situation.

The blackening range starts from the burning range end. It is roughly two to three times the burning range, depending upon the firearm, the ammunition and other factors.

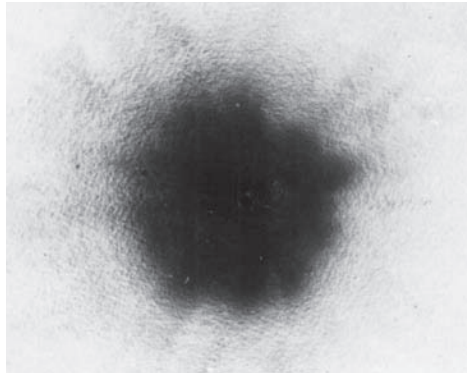


Fig. XIV-3

Blackening - a close range phenomenon.

1. Kindly see Chapter 13 on *'Gunshot Residues'.*
2. *Ibid.*

In a case of murder, the culprit fired two shotgun shots at the victim in broad day light on a railway station. The victim died immediately. Many persons saw the killing. They caught him red-handed with the smoking gun and handed him over to the police.

The case, after completion of the investigation, came up in the court. The court found the accused guilty and convicted him.

The accused appealed against the conviction. The defence plea was that the medical evidence was at variance with the eyewitness accounts. There were four sets of entrance wounds according to the medico-legal officer. The eyewitnesses had stated that the convict had fired only two shots. The defence counsel argued that even if we accept that the convict fired two shots, some other person fired the other two shots. There is no reason the killer shots were not fired by the unknown person. The convict, therefore, must get the benefit of doubt.

The appellate court sent the case to the author to ascertain whether the given injuries were caused by two or four shots. The following observation/experiments were performed:

1. *The crime weapon was a standard 12-bore DBBL shotgun, one barrel was cylindrical, the other was choked.*
2. *The cartridges fired contained LG shots*
3. *The injuries found by the doctor were:*
    - *3 grazing injuries on the left shoulder (Injury No, 4). Nitrite particle were discovered on the shirt, the intermediate target.*
    - *One (No. 1) injury just above the left ear. The wad and 2 LG shot had been extracted from the injury. It indicated a close range shot. Part of the charge had not entered the body*
    - *Two (No. 2, 3) through and through injuries (entrance and exit) below the jaw bone*
    - *Injury (No. 5) A single entry hole of about 1" diameter. It was a shotgun injury from close range where the full ejecta of a 12-bore shotgun LG cartridge had entered the body en masse*

Extensive experimental firing was done with the suspect's firearm and similar ammunition, on inanimate bust models, from various close and intermediate ranges and at different angles. The pattern of the injuries could be duplicated from a range of about one to three metres on varying the angles of fire. The representative patterns on the models were exhibited in the court.

The Apex Court (SC) accepted the reconstruction with the following remarks[1]*:*

"We have given our most careful consideration to the medical evidence in the light of the above quoted authorities on medical jurisprudence, the deposition of Dr. B.R. Sharma and the contention of Mr. Sibal and our conclusion is that the latter cannot prevail and that the opinion of the ballistic expert, substantially in accord as it is with the said authorities, deserves acceptance."

The conviction was maintained. (CH)

1. *Om Prakash* v. *State of Haryana*, AIR 1971 SC 1388. Extracts in chapter 24: *Case Law.*

2.6 Tattooing

The tattooing is also called 'peppering' or 'stippling'. It is embedding of the unburned or semi-burnt powder particles into the target surface. These particles are slightly heavier than the smoke particles. They retain motion for a somewhat longer time/distance than the smoke particles. Consequently, the tattooing has a longer range, about one and a half times than that of the blackening range.

The age and the quality of the powder charge and the length of the barrel have a predominant influence on the range and intensity of the tattooing.

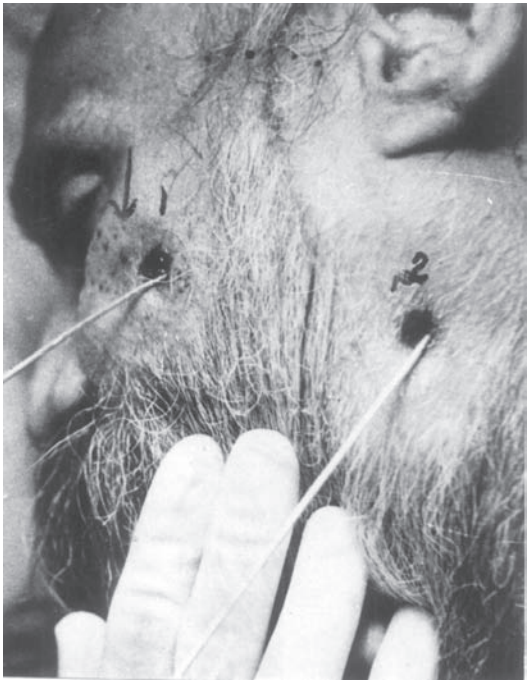


Fig. XIV-4

Blackening and tattooing can be seen around the injury (1) indicated by the arrow head. There is practically no such phenomenon around the injury (2). The difference indicates that injury (1) was from a closer range.

2.7 Metallic Residues

The GSR may contain lead, barium, antimony, iron, tin, copper, zinc, titanium, etc. Iron comes from the barrel. Copper, zinc and tin come from the projectiles or cartridge cases. Lead, antimony, barium and titanium come from the primers. Lead also comes from the lead bullets or semi-jacketted lead bullets due to vaporisation of the metal or due to scraping. They are propelled along with the other ejecta and help in the determination of the range.

The metallic residues may be propelled up to two to three metres or more. The elemental metal particles may sometimes be found at the target. They are scraped from the projectiles by the barrels. They form part of the projected charge. They being heavier, travel to a longer distance than the powder and

smoke particles. The range varies with the firearm, the ammunition and mainly with the size of the formed particles.

Fig. XIV-5

Scraped lead particles from a lead bullet fired from an improvised firearm.

The particles may or may not be visible to the naked eye. They are lifted on an adhesive tape and detected/identified by soft X-rays/chemical reactions/ Scanning Electron Microscope (SEM).

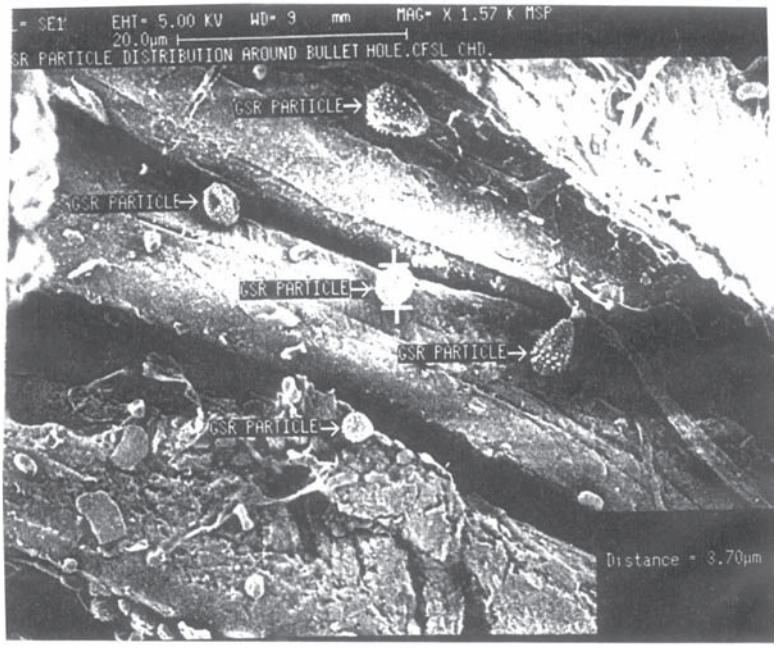


Fig. XIV-6

GSR particles around bullet holes, revealed by SEM, indicate close range.

2.8 Wad Distribution

A shotgun cartridge has a number of wads. They are ejected along with the other discharge materials. They enter the target up to about two to three metres. If they are not obstructed, they scatter from five metres to a long distance. If the distance between the victim and the wads is known, the range of fire can be determined.

The weather affects scattering of the wads. The wind, if it is there, determines the position (distance and direction), to which the wads travel. The wads may fall far away or nearer to the shooter. Sometimes they are blown even backwards. It depends upon the direction and the velocity of the wind at the time of firing. The weather conditions are taken into account, therefore, for the determination of range of fire from the scattering of wads.

Experiments were carried out with the 12 bore shotgun ammunition manufactured in India (by Indian Ordnance Factories) to study the scattering patterns of the wads. It was observed that:—

1. The majority of the wads scatter over a range of 3 to 50 metres.
2. The overshot wad was found the nearest while the cushion wad goes to the farthest point.
3. Some wads shredded. Over-shot wads frequently splintered. Even the cushion wad opened up in some shots.
4. The distances travelled by the splintered wads were inconsistent, as expected.
5. The cushion wads gave the most consistent and hence reliable results, for the determination of the range from wad distribution. The distances travelled by them were consistent and comparatively large, average 40 metres.

In USA, India and in some other countries a new type of wadding has come up. It essentially consists of an over-powder cup and a sleeve, power piston and pouch. They are not common in India yet, but manufacture has started. They should prove useful in range determination.

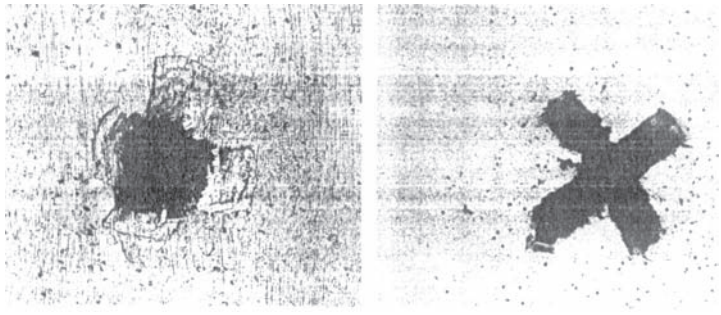


Fig. XIV-7

Presence of GSR along with opened up sleeve marks indicate close range.

2.9 Pellet Pattern[1]

The pellet charge of a shotgun covers increasing areas with increasing range. The area covered (pellet spread) by the pellets fired from a shotgun is controlled by:

1. The cartridge, the quality of the projectiles and its packing.
2. The firearm, especially by its bore characteristics (choke!) and its barrel length.
3. The range of fire: longer the range, greater is the pellet spread.
4. The weather condition; usually only strong winds affect.

Experiments, to obtain test patterns, are performed with the same firearm and ammunition of the same make and batch. They provide worthwhile and accurate estimates of the range. However, a number of shots, from various distances, are fired for comparison of the shooting case pellet pattern with the test patterns.

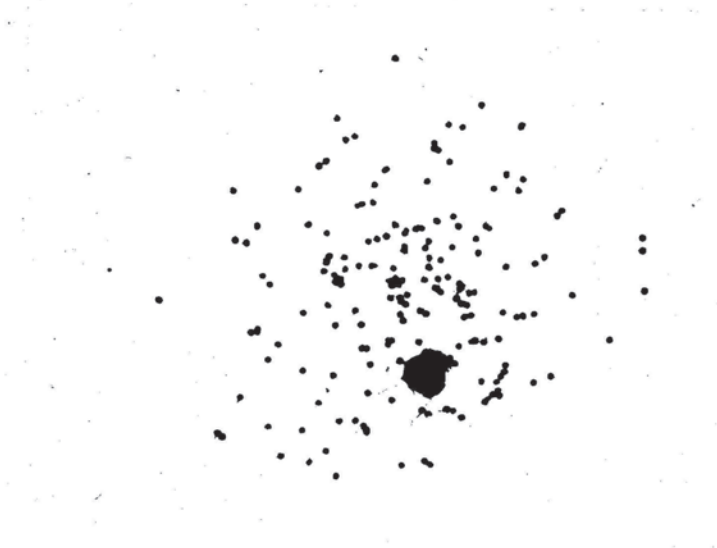


Fig. XIV-8

Rat-hole formation along with individual pellet holes from intermediate ranges.

1. Kindly also see section 4.2 of chapter 2: *Firearms*.

Fig. XIV-9

SG buckshot pattern and presence of wad mark (arrow) indicated close range. The medico-legal expert, preserved the skin (in formalin) and sent it to the laboratory.

Generally, the whole charge enters the body *en masse* up to a range of about two metres in a factory-made 12-bore shotgun. It forms a rat-hole of about two to six centimetres in diameter. The rat-hole is surrounded by individual holes when the range of fire is about two to seven metres. With buckshot charge, the individual shots may form separate holes from a range of about three metres. Most of the pellets separate from a range of about ten metres onward.

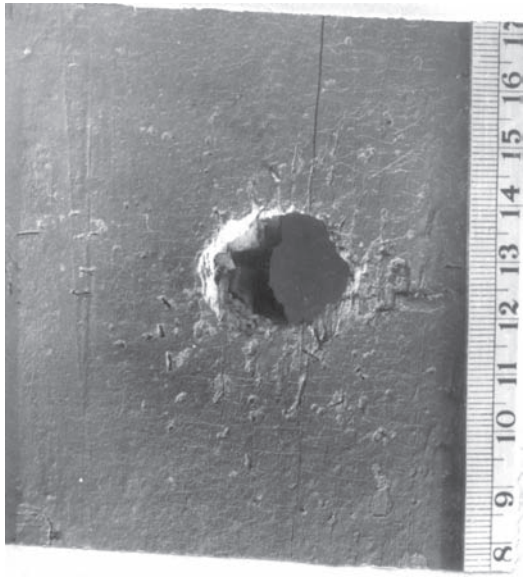


Fig. XIV-10

Angular 12 bore shotgun close range shot in a door leaf.

For standard firearms with *half choke*, range of fire, from the spread of the pellets, is obtained from the equation:—

$$D = 3 R$$

(Here, R = the range in metres, D = the dispersion diameter in cm.)

If the pellets have hit the target at an angle, they cover a greater area. The angularity of the fire, therefore, is ascertained from the direction of injuries before an estimate of the range of fire is made. The pellets, being small, do not permit accurate estimate of the angle of fire from the shape of entrance wounds. The wounds should be oblong but the smallness of the holes hinders the appreciation of the dimensional differences between the two axes.

The choke is constriction of the muzzle end of the firearm. It has a profound effect on the spread of projectiles. The table 1 below gives an idea of the effect of common chokes on spread.

Table XIV-1

SPREAD OF PELLETS AT VARIOUS RANGES WITH DIFFERENT CHOKES

Range in	*Diameter of the circle of pellet-spread (in centimetres)*			
Meters	*True cylinder*	*Improved cylinder*	*Half choke*	*Full choke*
10	54	38	31	23
15	71	55	44	33
20	88	72	58	45
25	105	89	73	59
30	122	106	90	75
35	140	124	108	94

The above table is not applicable to improvised pistols and guns made illegally by local blacksmiths. These crude firearms do not conform to any specifications. The barrels are either too loose or too tight and often short. The inner surface is rough. Consequently, pellet, patterns are not only different from the standard firearms but they vary in the same firearm from one shot to another. These firearms do not permit reliable range determinations.

Some researchers have come up with complex mathematical equations to predict the range-pattern relationship. However, too many variables are involved. Consequently, the calculated results seldom correspond to actual experimental results. It is author's considered view that test firing with the same gun and with similar ammunition give the most reliable results.

2.10 Direction of Wound

If the direction of the wound is not parallel to the ground level and the angularity is not due to the deflection of the projectile, an accurate estimate of the range of fire can be made. At least the prosecution or the defence version can be verified.

In a murder case, the prosecution story of the occurrence was that the deceased and the accused were standing at the time of occurrence, on their respective roofs across the street. The street was three metres wide and the roofs were at the same

level. The accused fired a pistol shot and killed the victim. The wound of exit on the back was five centimetres above the level of the entrance wound on the chest.

The defence filed an appeal against conviction, challenging the version. It produced a bust and a long probing rod with which they showed that the line of fire met the roof level at about two metres from the site position of the victim. The defence argued that the accused, therefore, could not kill the victim, as he was at least a metre away from where the line of fire met the roof level.

The High Court requisitioned the assistance of the author.

A careful study of the heights of the deceased, the accused and the positions of the entrance and exit wounds and the thickness of the body was made. It was shown, both mathematically and with the help of a graph paper that firing and killing was possible from across the street.

The defence in their demonstration had decreased the body thickness and increased the height of the exit wound. The angle of the line of fire was thus increased and the line met the roof level at about two metres away from the victim. (CH)

2.11 Injuries

Injuries can sometimes lead to the range of the fire:—

1. If the burning, blackening, etc. is observed inside the wound, instead of, or in addition to the phenomena around the hole, the firearm must have been fired with the muzzle pressed against the target.
2. If the edges of the wound are found ragged (star-shaped), the shot was fired in the contact or in the near contact position.
3. In a shotgun fire, if only one rat-hole is formed, the fire is from a close range.
4. If a projectile fired from the standard firearm and ammunition causes contusion or fails to cause extensive damage, the projectile must have expended its energy by travelling a long distance.

2.12 Marks

The marks at the scene of occurrence often provide clues to the range of fire even when there is no scorching, blackening and tattooing.

1. If there is only one mark on a wall, a window, a door or on furniture, it is difficult to ascertain the range of fire as the number of possibilities is large. By careful study of the height, shape and direction of the mark, it may be possible to estimate the range of fire in some cases.
2. If there are more than one marks produced by the same projectile it may be easy to find out the range in some cases. The axis of the barrel of the firearm may lie along the line joining the two marks. The shape, size and direction of the mark will help to verify the position.

   However, one must take care that:

   a. The projectile has not hit the surfaces after ricochet.
   b. The bullet path is not deflected.
   c. The same projectile produced the marks.

3. If a thick object like the trunk of a tree has been pierced and there is no deflection of the projectile, the line of fire will be the line joining the entrance and the exit holes in the tree trunk.

2.13 Various Ranges of a Firearm

A firearm has an extreme range up to which its projectile can travel. It has an effective range up to which, if the projectile hits a vital part, and proves fatal. It has an accuracy (of aim) range up to which a shooter can take aim and make a kill. The ranges vary with different firearms and ammunition even of the same type due to certain factors. However, the following table gives an idea of approximate range.

Table XIV-2

APPROXIMATE RANGES OF FIRE

	Range in metres		
Firearm	*Accuracy*	*Dangerous*	*Maximum*
Pistols and Revolvers	75	1000	2000
Service Rifles	1000	2000	over 3000[1]
Shotguns (buckshot ammunition)	75	200	600

1. The projectile may be dangerous even at the extreme range.

IMPROVISED FIREARMS

SYNOPSIS

1. **NATURE**
2. **IMPORTANCE**
   - 2.1 Trace Elemental Analysis
   - 2.2 Organic GSR
3. **CLASSIFICATION**
4. **STRUCTURAL CHARACTERISTICS**
   - 4.1 Barrel
   - 4.2 Chamber
   - 4.3 Action
   - 4.4 Lock
5. **FIRING PROCESS**
6. **EVALUATIONS**
   - 6.1 Cartridge-Firearm Linkage
   - 6.2 Bullet-Firearm Linkage
   - 6.3 Buckshot-Firearm Linkage
   - 6.4 Wad-Firearm Linkage
   - 6.5 Range Determination
   - 6.6 Wounding Power
   - 6.7 Time of Fire

15

IMPROVISED FIREARMS

1. NATURE

The improvised firearms are also known as *country-made firearms, homemade firearms, pipe-guns, zip guns, etc.* These firearms are made by ordinary blacksmiths to no particular specifications, nor are any standard material used. These weapons have short span of life and most of them are extremely dangerous. The word "improvised" indicates the nature of the firearm. It is more appropriate to refer to this class of firearms as Improvised Firearms, rather than dubbing them as country-made firearms, etc. However, in India, the names: 'country-made' and 'improvised' are being used frequently. Both the names have been used in this discussion, interchangeably.

The country-made firearms are improvised, usually by a blacksmith from readily available materials. Their use has increased so much (especially in UP, Bihar and in some border states), in recent times, that criminal gangs have come up in many parts of the country, who manufacture them on commercial scale.

> *The simplest improvised firearm, which has been used in a crime, was an iron tube in which a.22 cartridge could be fixed. The firing was done simply by hammering the base head of the cartridge. (CH)*

The stringent controls on the manufacture and sale of firearms and ammunition and the inhibiting firearm licensing policy have promoted the production/sale of the country-made firearms. No person in India can get a firearm licence and keep a gun unless the police clear his name, after the verification of his antecedents. The high cost of the firearms has also promoted the illegal firearm traffic.

Further, only a firearm licence-holder can purchase ammunition. The quantity of which is also limited and the limit is specified in the licence itself. The culprits, who need arms and ammunition, purchase them from illegal sources/markets.

The country-made firearms, as already seen, are non-standard firearms. They are not tested or 'proved' for their fire-worthiness. The weapons, therefore, are highly dangerous contrivances even to those who use them. Besides, they are also not amenable to standard techniques used for evaluating forensic ballistics problems generated by them. The data pertaining to the standard firearms has no relevance in relation to the improvised firearms.

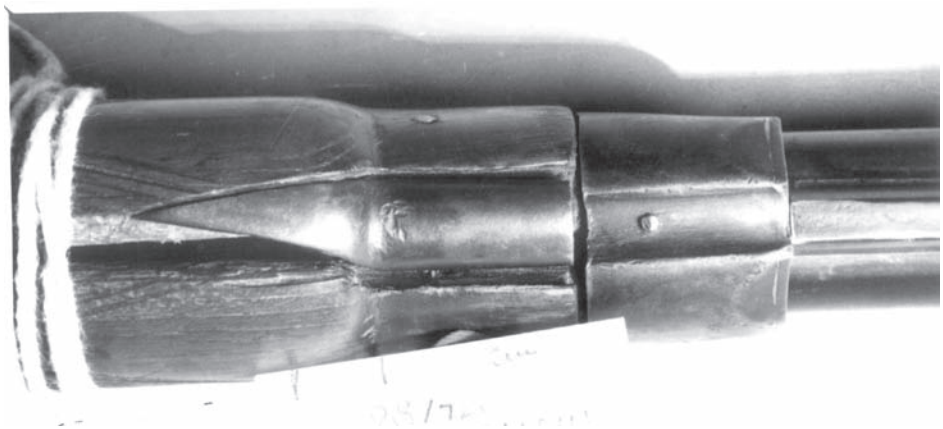


Fig. XV-1

Reassembled parts of an improvised firearm, shattered in the firing process, injuring the culprit seriously.

2. IMPORTANCE

The firearm is a great leveller. It empowers the weak to fight the hefty on equal footing. They spell death to those against whom they are used. The possession of the firearms, thus, confers a status of superiority, confidence and courage to challenge the adversary or to hold sway over those who do not possess them. They are frequently misused to commit crime, in settling scores with the opponents or cowing down rivals, or to frighten the weak and the poor in crime situations.

As the standard firearms are not easily available to the criminal fraternity, they go in for the improvised firearms in India. A large percentage of firearms used in crimes, is of the improvised firearms. It varies from state to state, from about twenty-five percent to over fifty percent. Therefore, they are forensically important to all those who are involved in handling crime.

The country-made firearms are crime weapons only, involved in crimes of all sorts, like murders, robbery, factional fighting or in disruptive activities. They, like standard firearms, often provide clinching evidence, linking the criminal with the crime, the victim, with the scene, etc. *inter se*.

The information, which an improvised firearm provides is varied. In general, it can be ascertained that:

1. The firearm is fire worthy.
2. The firearm has been fired recently.
3. The given fired cartridge case, found at the scene, was fired from the given firearm. It is possible in most of the cases. However, in some cases, the mark bearing area of the shell is shattered when it may not be possible to link the firearm with the fired/shattered cartridge case.
4. The fired projectile had been fired from the given firearm. It is not possible to link a fired projectile with the improvised firearm in all

cases. The projectiles do not fit snugly in the barrel to pick up the barrel marks. Sometimes the diameter of the barrel is too large to house the projectile properly. The bullet/projectile tumbles in the barrel and pick up marks haphazardly, which are unfit for firearm-projectile linkage.

5. The firearm has been fired from a close range; which is possible to establish from close range phenomena: deposition of GSR around the wound/hole.

Formerly, only limited evaluations of the evidence were possible. Fortunately, over the past few decades new grounds has been broken and country-made firearms provide practically the same evidentiary value as the standard firearms. Significant developments are:

2.1 Trace Elemental Analysis

Trace elemental analysis of the GSR from the victim/scene links the fired (crime) ammunition with the firearm/shooter/similar live ammunition seized from the suspect. Advances in analytical technology have made it possible to identify and quantify even the tiniest trace to give its trace elemental profile. Comparison of the trace profile with the trace profiles of the GSR from the other sources (culprit, his firearm or his live ammunition) links them *inter se*.

Trace elemental profile is especially useful in those cases where the culprit(s) have used improvised homemade ammunition, which usually have more identifying features in their traces than those in the standard ammunition.

2.2 Organic GSR

Formerly, the organic GSR was not given much importance, as their identification/quantification was not well established. Recent advances in analytical sciences have changed the scenario. There are numerous organic compounds in modern ammunition (more than 20). They vapourise and deposit at the target(s). An organic GSR profile can be built from the GSR. Comparison of the crime profile with standard profiles links/de-links the accused with the crime.

3. CLASSIFICATION

There is no workable or useful classification of improvised firearms. Each one is different from the other. The only classification possible is with reference to the ammunition used in them. Thus, we have 12-bore firearms and .303 firearms. The former fire 12-bore cartridges and the latter fire .303 cartridges. As the ammunition of the other types of firearm is not easily available (and it is very costly!), country-made firearms for the other bores or calibres are rare, though sometimes improvised revolvers of .32 and .38 calibres are also seen.

The country-made firearms are also classified according to the manner in which they are fired. Thus, we have the shoulder firearms or the handguns. The country-made handguns are more popular as they can be carried/concealed easily.

The country-made firearms, largely, have smooth bore barrels, though some handguns do carry rifling, often in a crude form, more to satisfy the purchaser than to improve the ballistics of the arm/ammunition.

4. STRUCTURAL CHARACTERISTICS

Country-made firearms have the usual parts:

1. The Barrel
2. The Action
3. The Lock
4. The Stock

4.1 Barrel

Country-made firearms have non-standard barrels. They are often pieces of iron or steel pipe used in the sanitary or electrical work. They are seldom made by boring the steel rods. The length of the barrel varies from about 10 to 25 cm in the case of handguns, and about 60 cm in the shoulder firearms. The country-made 12-bore firearms are also made from barrels of the discarded muzzleloaders.

The following points are note-worthy about the barrels in such guns:—

1. The diameter of the bore (calibre) seldom corresponds to that of a standard firearm. It varies from 1 cm to 2.5 cm usually. It may even vary from one point to another in the same barrel.
2. The bore surface is never smooth. It may have ridges, valleys, protrusions, pits, etc.
3. The thickness of the barrel walls generally differs from one firearm to another.
4. The barrels often have a welded seam (to form a pipe from a sheet) which is the weakest structural feature of the barrel.

The barrels of the country-made firearms, intended to fire .303 cartridges, have the following noteworthy characteristics:—

1. There is no rifling in the barrel.
2. The diameter of the barrel varies from 7 to 13 mm. It is not uniform.
3. The barrel wall is usually thick and varies from firearm to firearm.
4. The bore surface is rough. It carries pits and protrusions, ridges and valleys.

The barrels of the other bores/calibre country-made firearms have barrels characteristics similar to those mentioned above.

The loose, rough and the non-uniform barrels of the firearms are responsible for the varying ballistic performance of one shot to another.

Improper materials, the presence of joints, protrusions, etc. in the barrels make these weapons highly dangerous for the user.

Interestingly, the weapon becomes less dangerous to the victim as the ammunition does not acquire the intended velocities. Both the aim and the range suffer drastically. However, they remain highly dangerous at close ranges, at which they are usually used.

4.2 Chamber

The country-made firearms usually do not have specially made chambers. In most of them, the barrel end serves as the chamber and there is no special provision (leed) or separation of the chamber from the barrel bore.

If the bore diameter is more than the diameter of the base of the cartridge, a special arrangement (some sort of adapter is attached to the chamber end) to prevent the slippage of the cartridge into the barrel. In crude firearms, the slippage is prevented by wrapping a piece of cloth or paper around the cartridge tube at the chamber end.

The chambers of country-made firearms, if they exist, do not have proper dimensions, nor do they have any arrangement for seating the cartridge correctly. Consequently, the cartridge often rests loosely in the chamber, which is an important additional factor for varying ballistics given by different shots fired from the same firearm.

The loose chambers also cause cartridge bursts. A tight chamber imprints the chamber irregularities on the cartridge tube, which facilitate their identification. It is so in cases of excessively damaged or blown off percussion caps.

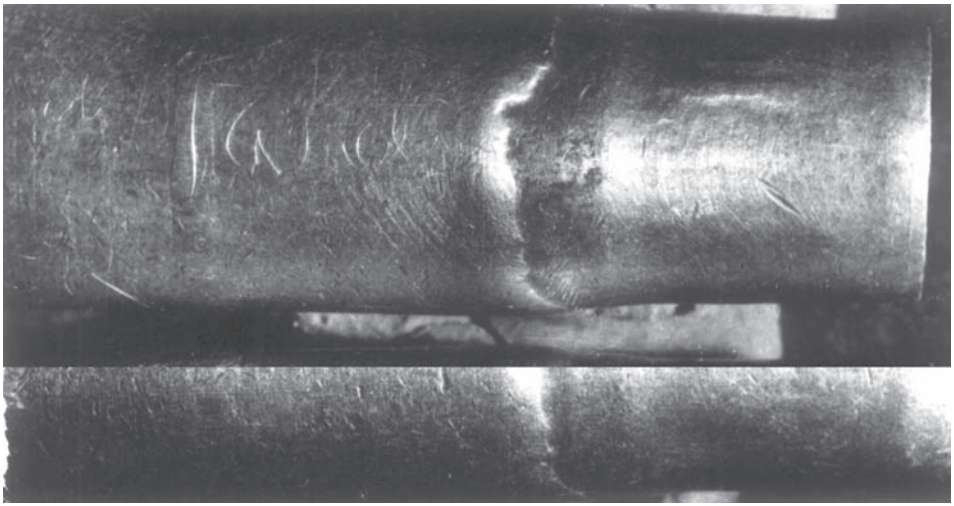


Fig. XV-2

Short chamber of an improvised. 303 pistol, created chamber edge (leed) marks on the fired cartridges, which permitted identifications of the common source.

4.3 Action

The hammer, trigger, and the firing pin (striker) are the important parts of the action mechanism. Often the hammer is cocked manually. It is held in the cocked position through a spring mechanism. When the trigger is pressed, it releases the hammer and the spring makes the hammer strike the firing pin with a considerable force. The firing pin, in turn, moves forward and strikes the percussion cap; thus, firing the cartridge.

The main distinguishing characteristics of the action are:—

1. The firing pin is more or less a headless nail. In some cases, the head of the nail was also observed. It is propelled forward by the striking hammer and kept pushed in, in its new position. Often it is slightly longer than needed and pierces the percussion cap. Thus, gases leak backward. The leakage reduces the forward propulsive forces/the velocity/kinetic energy of the projectile(s).
2. The piercing of the cap complicates the identification of the firing pin marks on the cartridge case. Backward leakage of gases, through the pierced hole, takes place. It causes more powerful backward thrust. The base of the cartridge strikes the breach face with greater force and thus, picks up clearer breech face marks. As the breech face of the country-made firearm is crudely finished, it carries numerous irregularities, which leave their marks on the cartridge case. They provide easy linkage of the fired cartridge with the firearms.
3. In some cases, the firing pin (without a spring) continues to press the cartridge percussion cap. In such cases, the protruding firing pin scrapes the percussion cap and base of the cartridge when it is being taken out. It creates the scrape marks, which provide ample evidence to link the fired cartridge and the firearm *inter se*.

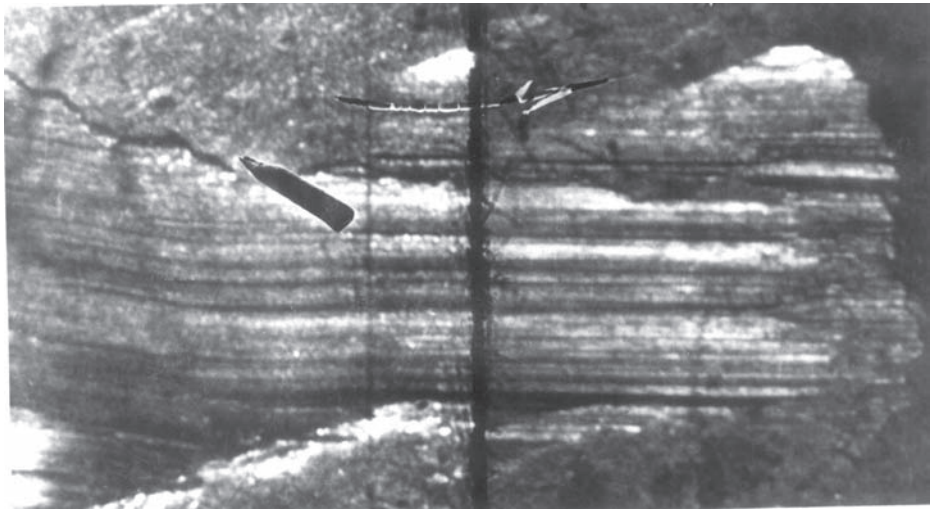


Fig. XV-3

The firing pin of an improvised firearm would not retract. On opening the breech it scraped the base. Correspondence in scrape marks provided the identification.

Breach face marks make the identification of a fired cartridge in respect of the used country-made firearm often easier.

4. The firing pin in country-made firearms is easily replaced. The clever criminals have at times replaced the firing pin or mutilated its original

surface profile. The fraud does not help them much. The breech face marks provide the necessary identification data.

In an interesting case, a criminal, after killing his victim with his gun, went to a blacksmith and got the firing pin replaced. He also obtained a receipt from the blacksmith for the service rendered. Later, the police seized the firearm with due legal formalities in the presence of the accused (culprit) and a magistrate and then sent it to the laboratory, along with the recovered fired cartridge case.

The author observed the tampering of the firing pin; but still he gave a positive opinion linking the cartridge case recovered from the scene with the weapon recovered from the accuse on the basis of the plentiful corresponding breach face marks on the crime/test cartridges .

At the trial, the defence counsel produced the receipt (dated in between the date of murder and the date of handing it over to the police) of the repairs. The prosecution counsel was upset. The author was called for the evidence. He clarified that though the firing pin marks differed on the test and crime cartridge cases; there was still ample evidence, in the form of breech face marks, to link the firearm with the crime cartridge. The replacement of the firing pin, the fraud played by the culprit, did not succeed. (CH)

4.4 Lock

The locking systems of the country-made firearms are notoriously unreliable. There is no proper barrel-stock coupling system. The locking device is often a nail and hole arrangement. In some cases, the overlapping of parts makes them unsafe. Often there is a gap between the breechblock and barrel. The gap promotes cartridge bursts.

5. FIRING PROCESS

The poor construction of the firearms affects the firing process in the following ways:—

1. A longer and non-retractable firing pin pierces the percussion cap of the cartridge. It adversely affects the initiation of the powder charge, modifying the intended ballistics of the ammunition.
2. The gap between the breech face and base of the cartridge allows the backward movement of the cartridge. Sometimes the cartridge bursts and seriously affects the development of adequate pressure, which in turn affects both the aim and the range. The extent of the effect varies from firearm to firearm and even from one shot to another shot. Metallic pieces may fly when a cartridge bursts, injuring the shooter or bystanders.
3. Over-sized chambers promote lateral expansion, which affect the development of a forward pressure. In some cases the cartridge bursts, which seriously affects the ballistics of the ammunition.
4. An oversized barrel bore allows the escape of the gases from the sides. It affects the ballistics of the process in the following ways:—

a. The gases escaping from the sides do not contribute towards the velocity of the projectiles. The kinetic energy of the projectiles is reduced.
b. The escaping gases do not build up the pressure. It gives incomplete combustion. It reduces the velocity of the projectiles.
c. The projectiles, due to the above reasons, have lower wounding power.

5. The oversized bore prevents a continuous bullet-bore contact. The random contact may or may not imprint adequate contact marks on the bullet for the bullet-barrel linkage.
6. In undersized barrel bore, the firearm may burst, but it seldom happens. It is probably due to the incomplete combustion, backward movement of the cartridge, punctured percussion cap, bursting of the cartridge itself, etc., which prevent the frequent firearm/barrel bursts.
7. The combustion of the powder charge of the ammunition, meant for a long barrelled firearm, is not completed in the short-barrelled country-made firearms. Consequently, the semi-burnt/unburned powder particles in considerable amounts are also ejected along with the projectiles and other ejecta.
8. The incomplete combustion inhibits a complete and proper development of pressure. The projectiles, therefore, do not acquire standard velocities or striking energies. The wounding power of the projectile fired from a country-made firearm is considerably reduced.
9. The country-made firearms do not have rifling. The projectiles fired from them, therefore, do not acquire a spin. The aim and range are consequently, seriously affected, even when the bullets fired are of standard rifled firearm ammunition.
10. As the semi-burnt/unburned powder particles are also hurled along with the other ejecta, they may increase the powder range. The data for standard firearms do not hold good for the country-made firearms.
11. The rough bore surface scrapes metal particles from the projectiles. The particles travel to a greater distance than those in standard firearms. They give false estimates of the range, if the data of the standard firearms is used for the range determination.
12. In an excessively large bore, the bullet may bend due to striking against the barrel walls at an angle. The bent bullet may mislead the investigator as the bullets also bend in some ricochets.
13. In both the oversized and undersized bore barrels, the wads are damaged or marked in a particular fashion. The characteristic change may help the wad-firearm linkage.

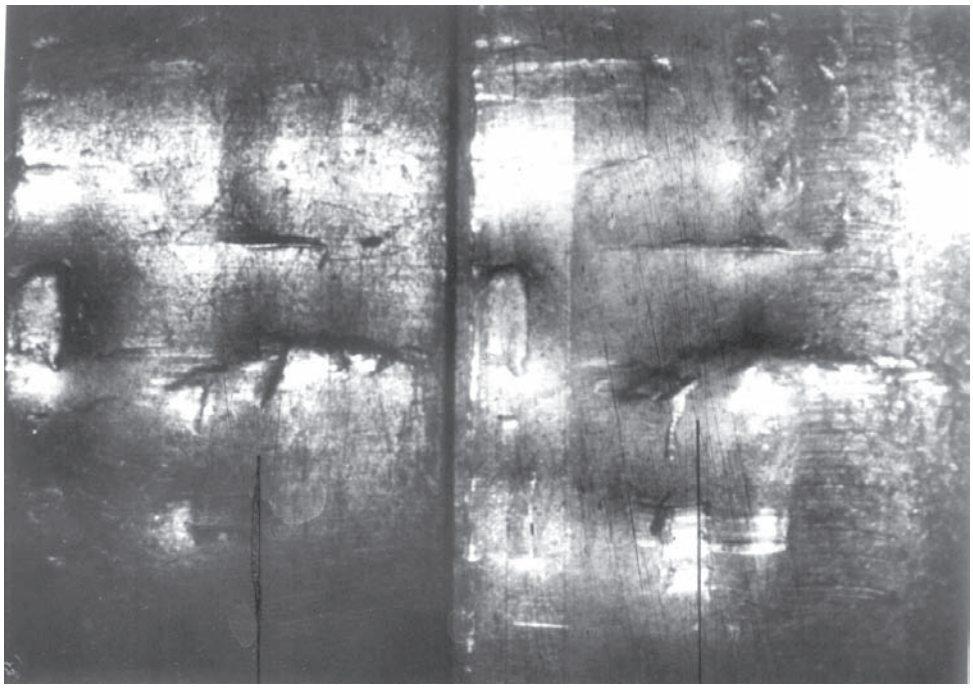


Fig. XV-4

Undersized chamber of an improvised firearm marked the cartridge extensively and characteristically.

6. EVALUATIONS

The main evaluations in cases involving improvised firearms are similar to those in the standard firearms:—

1. Cartridge-firearm linkage.
2. Bullet-firearm linkage.
3. Buckshot-firearm linkage.
4. Wad-firearm linkage.
5. Range of fire determination.
6. Time of fire determination.
7. Wounding power determination.

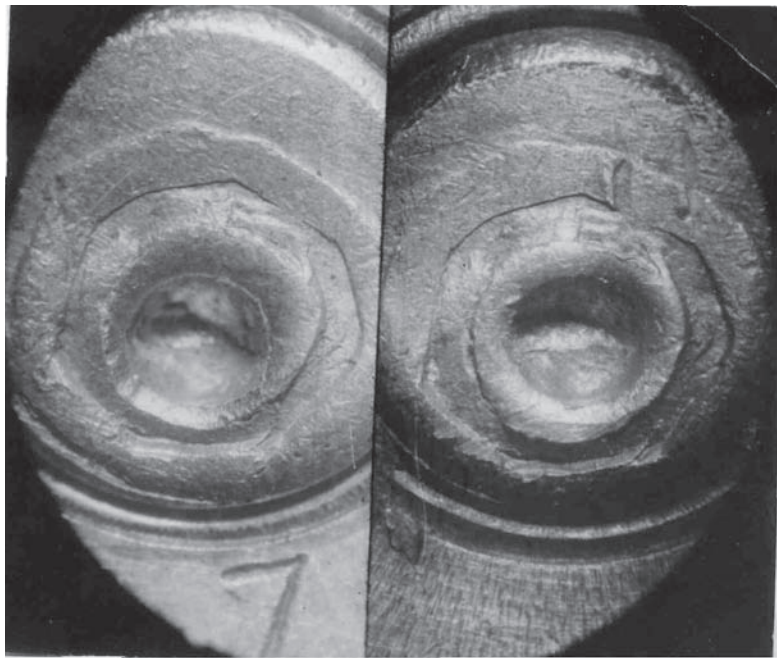


Fig. XV-5

Matching pair of marks: from striker and breach face. Improvised 12 bore pistol.

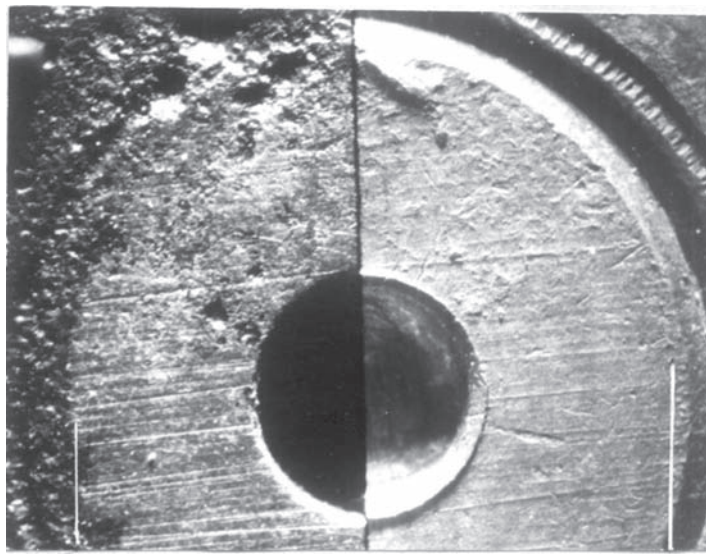
6.1 Cartridge-Firearm Linkage

Fired cartridge cases are linked with the suspected firearm though the marks, which the latter imprints on the cartridge in the firing process, just as in the case of standard firearms. However, the country-made firearms offer some peculiar situations, which have are taken into consideration to establish the linkage. They are:—

1. The firearm may be unsafe and not amenable to fire test cartridges normally. The difficulty is overcome in most of the cases by the following processes:—
   a. The firearm, after loading, is fixed in a vice, in such a way that it cannot come out of the same even on firing. The vice is then kept in a bullet recovery box. The weapon is cocked and the trigger is pulled through a string from a safe distance. Further protection to the shooter is ensured by screening the box with a strong board placed in between the shooter and the vice. Whenever possible, the two parts at the breech are so secured in the vice that they do not go apart on firing.
   b. The powder charge is reduced suitability. The damaged fired cartridge, the barrel-breech gap and the constructional material of the country-made firearm guide the extent of reduction of the powder charge.
   c. In cases where the firearm is damaged and rendered incapable of firing, the firearm parts imprinting the marks are directly compared with the marks on the crime cartridge. Alternatively, a cast of the marks is

obtained on a suitable material. Plasticine, Kerr's dental mass, cellulose acetate solutions, lead or Woods metal have been used for the purpose successfully.

In an interesting case, the hammer of an improvised firearm (a pistol) was so jammed that even with the best efforts the firearm could not be fired in the normal way. However, the author test-fired the firearm by hammering the hammer. The appellate judge could not understand how the firing was done. Consequently, he summoned the author. The appellate judge had a hearty laugh when he saw how the effort of the culprit to destroy the evidence was nullified by just hammering the hammer! (CH)



1 **2**

Fig. XV-6

Damaged firearm would not permit firing.
The breech face marks (2) Compared directly with the breech face (1).

d. The firearm is repaired (if possible) and the test cartridges are fired.

2. Firing pin marks are not available on the crime cartridges in many cases. The firing pin pierces the percussion cap and thus damages the marks, or, the percussion cap is blown off. The absence of the firing pin marks offers no serious problem, in most of the cases. The other marks, such as the firing pin scrapes, breech face, chamber and extractor marks are available. They permit linkage of crime and test cartridges and thus, link/de-link the crime cartridge with the suspected firearm.
3. In some cases, which involve shotgun ammunition, the base is separated from the tubular portion (cylinder) of the cartridge. The base carries the firing pin, breech face and/or the extractor marks. They permit the comparison of these marks with the marks on the test cartridges. The linkage/de-linkage is thus established. Likewise, the tubular part carries

marks from the chamber. The identification of the weapons through these chamber marks is also possible.

The base and the cylinder can be inter-linked through the mechanical fit at the torn edges, though it is unnecessary, most of the times.

The tear patterns on the tubular part of the burst cartridges cannot be duplicated, usually. They, therefore, seldom help to establish inter-linkage.

Fig. XV-7

Shattered cartridge cases—
but similar pattern in crime and test cartridges identifies the firearm.

6.2 Bullet-Firearm Linkage

The Bullet-firearm linkage in improvised firearms offers the following situations:—

1. The bore of the barrel is oversized *vis-à-vis* the bullet.
2. The bore of the barrel is of the same diameter as that of the bullet.
3. The bore is undersized as compared to the bullet diameter.
4. The bore of the barrel is non-uniform.

In the oversized bores, the bullet may or may not touch the barrel. It, therefore, may or may not pick up the marks from the barrel. If it does not pick up the marks from the barrel, no linkage of the firearm with the projectile is possible. If it picks up some marks, it is in a haphazard way. Usually they do not provide identification data. Efforts are made to obtain the corresponding test marks for comparison. Success is rare.

2. The test bullets are fired in a bullet recovery box. The marks are compared. The comparison may reveal adequate number of striations and link the crime bullet with the test bullet and thus, with the suspected firearm. The absence of the adequate number of matching striations does not de-link the firearm. However, if the test bullets give the same set of marks, different from those on the crime bullet, possibly the crime bullet was not fired from the firearm.
3. A loose barrel imprints the marks on the bullets repeatedly only if the chamber fixes the direction of the bullet, at a particular angle. The bullet fired from such a firearm scrapes the bore surface at the same point to give consistent marks. They permit fired bullets-firearm linkage. This is, however, rare.
4. The bullets make random contact with the bore surface. The contact is at different points of the oversized barrels for each shot. They will carry different marks from different portions of the barrel surface. They do not match, even though they have been fired through the same barrel. A bullet of a diameter marginally larger than the bore diameter of the barrel is pushed through the firearm. The test marks so obtained are compared with those on the crime bullets. The marks on the crime bullet are compared with the marks on the total surface of the test bullet (whole of the cylindrical surface from the base to the start of ogive. In some rare cases the comparison may provide a match and hence a linkage. In practice, this happens in extremely rare cases.
5. When a bullet of matching calibre is fired or pushed through the barrel, it comes in close contact with the bore surface. It picks up the irregularities from the surface. Such test bullets behave like the test bullets fired through standard firearm.

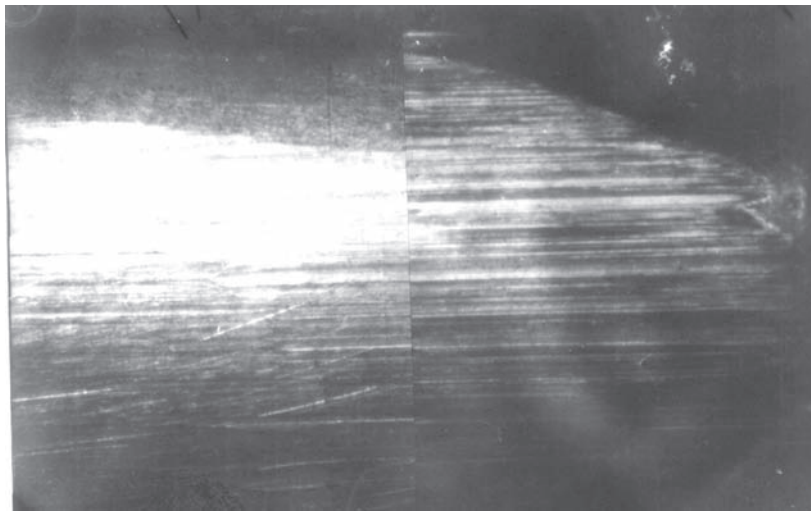


Fig. XV-8

Crime and test bullets' striations match. An improvised .303 pistol created the marks.

6. In those cases, where the test firing of the firearm is not feasible, the test bullets are obtained by pushing the bullets through the barrel. The bullets have to be of the matching calibre.
7. The undersized bore barrels in the country-made firearms are dangerous to fire because the barrel may burst. The projectiles of matching diameters are used to test-fire or for pushing through the barrels. They may or may not permit identification.
8. Some country-made firearms may have barrels of non-uniform bore. At some points, the bore diameter may be more than the diameter of the bullet and at other places, it may be the same, and yet at other places it may be less. These types of barrels offer some difficulty for linking them with the bullets fired through them. In fact, such a barrel behaves like an undersized bore barrel for all practical purposes even if the bore is undersized only at one point. The only difference is that the bullet, while passing through the oversized portions of the barrels, may come in random contact with the barrel surface and pick up some marks from that portion. These irregular marks intermingle with the regular marks from the same sized or undersized portions of the barrel and interfere in the identification process. Nevertheless, they are only on a small portion of the projectile. They can be ignored.
9. The smooth bore barrels are called smooth only because they do not have the rifled lands and grooves. The surface irregularities of the bore surface are similar to those found on the rifled firearms. The individualising marks on the projectiles left by the smooth bore barrels are in no way different from those left by the rifled barrels. Only the class characteristics provided by the lands and grooves are not available. The linkage of a bullet *vis-à-vis* the firearm is based on individual marks and not on class characteristics. The absence of class characteristics therefore, does not affect the correctness of the identification.

6.3 Buckshot-Firearm Linkage

The identification of the barrel marks on the projectiles from a multi-projectiles cartridge has always been difficult. The small size of the projectiles, their turning movement and lateral shift are responsible for the difficulties. They are accentuated in country-made firearms due to the non-standard barrel dimensions, improper firing process and the shorter barrel lengths. However, the basic principles of the country-made firearm-buckshot linkage are the same as those in the standard firearms. The following points peculiar to the country made firearms-buckshot linkage may be noted.

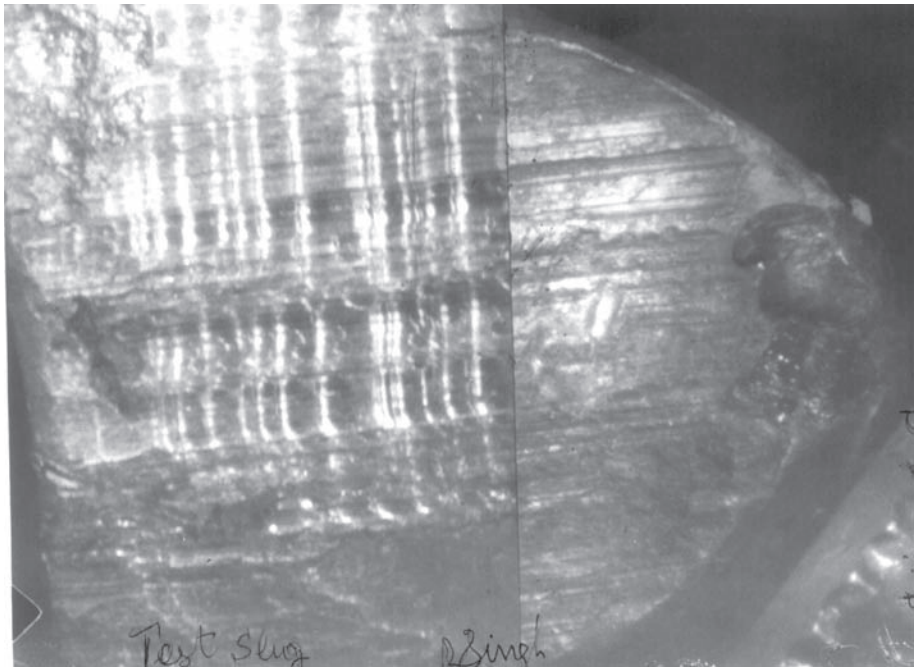


Fig. XV-9

Matching striations on a crime LG buckshot with the test striations obtained on a pushed slug from the suspect country made pistol.

1. To establish the buckshot-firearm linkage, it is essential that the projectile charge should travel *en masse* through the barrel and the projectiles have only a forward movement and no lateral or turning movement. This is possible in the case of those country-made firearms, which have the barrel bore diameter of 1.7 to 1.9 cm, to fire 12 bore shotgun cartridges. If the barrel bore diameter is larger or smaller, the displacement of the charge is possible. The buckshots, consequently, would not remain in contact with the same continuous segment of the barrel from the breech end to the muzzle end. Instead, they would touch the barrel at different points at random and the marks imprinted on the buckshots would vary. In brief, linkage of the buckshot and the firearm is not always possible. It is possible only in those cases where the bore diameter of the barrel corresponds to the diameter of the charge package fired from the barrel.
2. The test slugs carrying the cumulated marks obtained from the irregularities of the bore surface are prepared by pushing or test firing the slugs of the correct diameter through the barrel. A better innovation is to replace the projectile charge with a lead cylinder of about two cm length and diameter corresponding to the diameter of the barrel bore. The cartridge is then fired from the firearm with the slug.
3. The comparison of the marks on the test and crime projectiles is done in the usual way. The work is highly tedious and is not carried out as

routine anywhere. It is hoped that the computer technology (IBIN), being used for bullet and cartridge comparison, would ultimately permit the automatic profile comparison and the identification of the buckshots in all cases, routinely where barrel marks are available on buckshots.

4. Modern shotgun ammunition has now a plastic power-piston pouch for the projectile charge. The plastic sleeve prevents abrasion of the projectiles (buckshot). They do not pick up barrel marks to allow *inter se* linkage of the buckshot with the barrel.

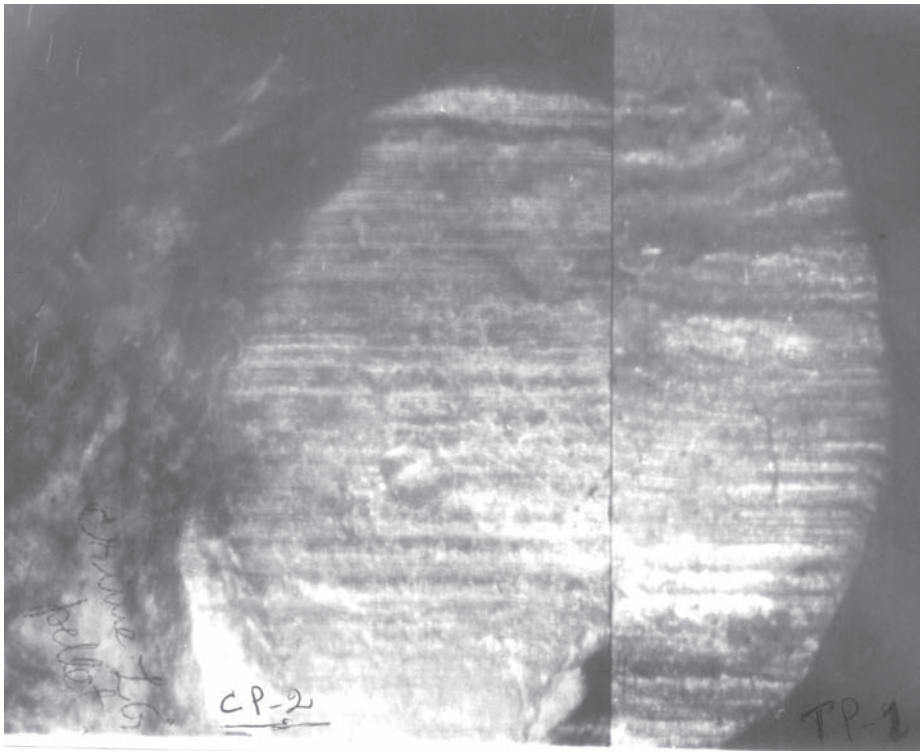


Fig. XV-10

Composite photomicrograph of striation marks on crime and test LG buckshot from a country made pistol.

6.4 Wad-Firearm Linkage

Wad-firearm linkage has not been reported in cases involving standard firearms. This linkage is also not common in country-made firearms. It is rare:—

1. When the bore diameter of the barrel or chamber is large, the smoke may be deposited on the cushion wad. The cushion wad picks up striations on this surface, covered by the smoke, from the barrel during its passage through the same. These striations are identifiable in respect of the firearm in some cases.

2. In rough, undersized bores, the cushion wad can also pick up some marks from the prominent irregularities with which it comes in contact. The marks thus created can provide the wad-firearm linkage.
3. GSR present on the wads and the GSR in the barrel/firearm may be inter-linked through trace elemental/organic compound profiles. The process has not been tried so far, to the best of author's knowledge.

The test striations for the comparison of the marks on the wads produced as in (1) and (2) above. They are obtained on the test slugs as described earlier. A comparison microscope is used for comparison. The success is elusive in most of the cases.

Ordinarily, the cushion wad alone is useful for the wad-firearm linkage. It has an adequate space on its cylindrical portion to register marks. If the cushion wad opens up, the identification may not be possible.

Theoretically, the other wads can also pick up the striation marks from the barrel. Such marks are seen sometimes on the smoke-covered wads, but nobody has reported using them for identification.

The plastic cup or sleeve of the 'power piston pouch' and sabot scrape the barrel. They may be marked with striations while passing through the barrel, if it is not an oversized bore. These marks are like those on bullets. They can permit identification, provided the cup of the power piston comes in close contact and not damaged extensively. In oversized bore barrels, the cup of the power piston may or may not pick up identifiable marks from the barrel.

6.5 Range Determination

There is an unfortunate tendency among the investigating officers, the lawyers and the judges to accept/use/apply the range data collected from similar ammunition and standard firearm in the cases involving country-made firearms. They do so under the fallacy that the range of fire is mainly the function of the ammunition. This misconception leads to serious wrong range estimation.

In the case of country-made firearms, the opinions on range of fire based upon data collected for standard (or other country-made firearms) are not only useless but misleading also. No such opinion should be expressed or accepted.

If a 12-bore cartridge is placed in a burning fire, it will explode with some noise. It will spurt in the fire, without its projectiles acquiring sufficient velocity to injure anybody seriously. On the other hand, if the same cartridge is exploded in a closed space, it can burst the container, turning the flying pieces into deadly missiles.

The behaviour of a cartridge fired from a country-made firearm varies between these two extremes.

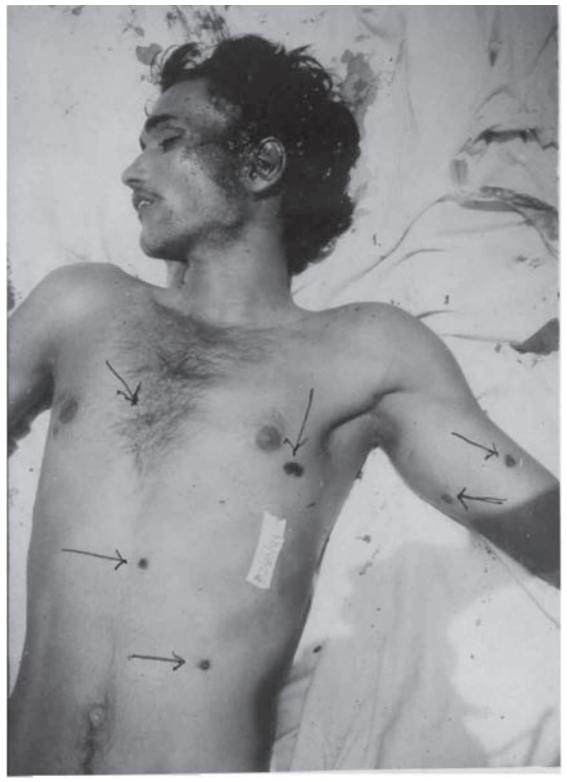


Fig. XV-11

Spread of LG shots from three metres. Shot fired from improvised firearm with 4" barrel.

It is true that a cartridge plays an important part in determining the behaviour of its projectiles and other products on firing, but the firearm through which it is fired, plays the determining role. For example, a .303 cartridge, when fired from a standard rifle, may travel 3 kilometres or more and kill a person at that range. However, the same cartridge, if fired from a smooth bore country-made pistol with a 10 cm barrel length and of about 10 mm bore diameter, may be ineffective even at 100 metres. It is, therefore, essential to discard the misconception about range of fire that it will be the same for country-made/ standard firearms.

The range of fire data, compiled for standard firearm-ammunition is not valid for improvised (country-made) firearms.

Every part of the firearm influences the range of fire. The following parts, however, play a predominant role:—

1. The length of barrel, in a short barrel the combustion of the powder charge is incomplete. Consequently, the intended pressure, velocity or kinetic energy is not developed.
2. The bullet tumbles when a .303 rifle cartridge is fired from a smooth bore barrel of larger diameter.

3. When the barrel bore is oversized, the projectiles or wads do not seal the bore and the gases escape from the sides. The projectiles thus, do not acquire the intended velocities or energies.
4. An oversized or an undersized chamber may burst the cartridge, inducing incomplete combustion and dissipation of pressure in all directions, reducing the velocity and energy of the projectile considerably.
5. A gap between the breech end and action mechanism (due to improper alignment) may cause burst of the cartridge, affecting seriously the ballistics of the projectile.
6. The weak breech joints may open the breech on firing, affecting adversely the ballistics of the projectile.
7. The protruding firing pins pierce the percussion caps. This adversely affects the ballistics of the projectile.

In short, each country-made firearm is unique. It is different from all other country-made or standard firearms, even firing similar ammunition. The ballistics aspects of each improvised firearm differ from all other firearms drastically.

The standard ballistics data from the standard firearm-ammunition combinations have no relevance *vis-a-vis* improvised firearms. It is, therefore, essential that if the range of fire, etc. have to be ascertained in a particular case involving a country-made firearm, they must be based upon exhaustive tests with the suspected firearm, and ammunition of the same make and batch, if possible, to the one used in the crime. The opinion can be valid only if consistent and repeatable results are obtained. The latter is a rare phenomenon with country-made firearms. The poor construction of the firearms inducts changes almost in each shot.

Fig. XV-12

Individual pellet injuries even from 4m. shot from an improvised firearm. Barrel was 8" long

6.6 Wounding Power

The wounding power of a projectile depends upon its striking velocity, weight shape and nature of the material of the projectile, etc. Transference of kinetic energy of the projectile(s) to damage the body tissues, in addition, also depends upon the target site. The transfer of projectile energy to body has been discussed in the chapter on firearm injuries. The discussion therein mainly relates to the standard firearms. The country-made firearms modify the velocities, shapes and the other ballistic aspects of the projectiles significantly. The following points are noteworthy:

1. The drastic reduction in the velocity of the projectiles fired from country-made firearms adversely affects the wounding power of the projectile[1]. In real situation, however, it does not affect because the firearms are fired, mostly, from close ranges. They inflict fatal/serious casualties.

   The improvised firearms are useless, when fired from long distances where neither the aim nor the wounding power can be trusted.
2. The bullets are given a particular shape to ensure their proper flight in its trajectory. In country-made firearms, the shapes are modified (due to irregular scraping, bending in the oversized bore barrels or elongation in the undersized barrels, etc.). The changes influence the ballistics (aim, velocities, wounding power of the projectiles.
3. Absence of proper calibre and rifling in the improvised firearms does not ensure nose-onward position of the bullet when it strikes the target. Often it strikes the target laterally, due to tumbling etc. It may not penetrate the target, especially if the striking velocities are close to the thresh-hold velocities.
4. The improvised firearms have usually no rifling/proper rifling. The bullets fired from them, do not spin, they often tumble, affecting aim/range adversely. They may form keyhole wounds.
5. Bullets fired from the country-made firearms do not spin. They compress air to form an air wall. It increases air resistance, reducing the velocity of the bullet considerably. The aim is also affected.
6. Bullets fired from country-made firearms usually have low velocities. They, therefore, do not fragment. Consequently, the wounding effect/damage is less destructive.

6.7 Time of Fire

Country-made firearms offer no special features of importance as far as the time of fire determination is concerned.

1. Wounding Power of a projectile is $\alpha\ v^2$. If the velocity is reduced to ½, the wounding power is reduced to ¼; and so on.

MISCELLANEOUS IDENTIFICATIONS

SYNOPSIS

1. **GENERAL**
2. **FIREARMS**
   - 2.1 Firearm
   - 2.2 Calibre
   - 2.3 Air Gun/Pistol
   - 2.4 Fire-worthiness of a Firearm
   - 2.5 Accidental Discharge
   - 2.6 Firearm Fired
   - 2.7 Resuscitation of Serial Numbers
3. **AMMUNITION**
   - 3.1 Live Ammunition
   - 3.2 Fired Ammunition
4. **IDENTIFICATION OF THE SHOOTER**
   - 4.1 Nature of the Firearm
   - 4.2 Barrel Length
   - 4.3 Time Elapsed
   - 4.4 Propellant Used
   - 4.5 Primer Used
   - 4.6 Barrel Fouling
   - 4.7 Distribution of Gunshot Residues
   - 4.8 Collection of GSR
   - 4.9 Detection
5. **Muzzle-loading Firearms**
   - 5.1 Percussion Cap
   - 5.2 Projectile Charge
   - 5.3 Wads
   - 5.4 Powder Charge
6. **FRAUDULENT MANIPULATIONS**
   - 6.1 Filing
   - 6.2 Acid Treatment
   - 6.3 Replacement of Part
   - 6.4 Removal or Damaging of the Firearm Parts
   - 6.5 Wrong Ammunition
   - 6.6 Multi-Ammunition Firearm
7. **SPECIAL SITUATIONS**
   - 7.1 Damaged Cartridge Case
   - 7.2 Damaged Bullet
   - 7.3 Burnt Ammunition
   - 7.4 Heavily Fouled Barrels
8. **TIME OF FIRE**
   - 8.1 Black Powder Residues
   - 8.2 Smokeless Powder
   - 8.3 Dust
   - 8.4 Mercury
   - 8.5 Bloodstains and Flesh
   - 8.6 Rust

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MISCELLANEOUS IDENTIFICATIONS

1. GENERAL

In addition to the main problems relating to the identification of the cartridge cases, the bullets and the other projectiles, in respect of a firearm, there are also other identification problems. They occur less frequently, but they are equally important in some cases. The problems involve the study of various aspects of the firearms, the ammunition and the target.

2. FIREARMS

The important but minor identification problems relating to firearms include:—

(1) Is the given device a firearm? If so, what is its type?

(2) What is its calibre?

(3) What are the make, model and serial number of the firearm?

(4) Is the given firearm in prohibited category, under the Arms Act?

(5) Is the given firearm fire-worthy or in working order?

(6) Is the given firearm prone to accident? Is its safety device working?

(7) Was the firearm ever fired?

2.1 Firearm

What constitutes a firearm in law is given in section 2(1) of the Arms Act, 1959.[1] The definition in fact is all-inclusive and easily includes all the improvised devices, which are used or are intended to be used as firearm, their parts or the paraphernalia involved in their manufacture.

Whether a given device is a firearm or not, legally, arises mostly in cases involving toy guns and improvised firearms. A firearm has the following parts:

---

1. According to the Arms Act, 1959, a firearm means arm of any description, designed or adapted to discharge a projectile or projectiles of any kind by the action of any explosive or other forms of energy and includes:—
   (1) Artillery, hand grenades, riot pistols or weapons of any kind, designed or adapted for the discharge of any noxious liquid, gas or other such things.
   (2) Accessories for any such firearm designed or adapted to diminish the noise or flash caused by the firing thereof.
   (3) Parts of and machinery, for manufacturing firearms and cartridges, platforms and appliances for mounting, transporting and servicing artillery.

a. A firing mechanism
b. A chamber to house the ammunition
c. A barrel to provide for the controlled expansion of the gases and
d. Some safety device

Under the Indian law, even the part of a firearm or the machinery used for the manufacture of the firearm, constitutes a 'firearm' for prosecution purposes. The parts and the machinery, therefore, have also to be identified whether they are the part(s) of a gun or not. Alternatively, the machinery is related to the manufacture of the firearms.

2.2 Calibre

The determination of calibre (bore) is an important step to fix the identity of the firearm. It also indicates whether the given firearm falls in the prohibited or non-prohibited category.

The determination of calibre/bore is easy. A vernier caliper gives the same. A dial micrometer is used for its precise measurements. The diameter is measured across two lands in rifled firearms.

The exact measurement of the bore diameter, usually, does not correspond with the designated calibre of the firearm. For example, a .38 firearm may have diameter of .34 to .36" only. The designated calibre is nominal calibre or bore of the firearm.

Calibre of a firearm can also be determined from a bullet fired from the firearm. The diameter of the bullet, measured across the opposite grooves, gives its calibre... The undersize/oversize bullets may mislead.

Table XVI-1

NOMINAL CALIBRES (BORES) AND ACTUAL DIAMETERS

Millimetres	Hundredth *inches*	Thousandth *inches*	Actual diameters *millimetres*
5.6	.22	.220	5.38 to 5.61
6.35	.25	.250	6.1 to 6.34
6.5	.25, .26	.250, .260	6.1 to 6.34
7.5, 7.62, 7.63 7.65, 7.7, 7.9, 8.0	.30, .32	.303, .300, .320	6.6 to 8.0
9.0, 10.0	.35, .38	.380	8.72 to 10.0
11.0, 11.25	.44, .45	.445, .455	10.6 to 11.45

2.3 Air Gun/Pistol

An air gun or an air pistol may or may not be a firearm legally. The kinetic energy of fired projectiles (which is a function of the strength of its spring) decides. If the propelled projectile penetrates a certain thickness of soft pinewood, the weapon is a firearm[1]. It needs a licence. If it does not penetrate

1. The wooden planks, 2.54 cm thick, are stacked, parallel to one another, 2.54 cm apart. The firearm is discharged from 152.4 cm. If the thickness of the wood penetrated by the air rifle is 2.54 cm or more, it needs a licence. In the case of an air pistol, if half the thickness is penetrated the pistol needs a licence.

the given thickness, it is not a firearm legally and does not require a licence. The test mode is specified.

2.4 Fire-worthiness of a Firearm

The problem whether a given firearm is fire-worthy or not, arises mostly with improvised firearms. It also crops up in old, ill-kept and damaged firearms. The actual firing test indicates whether the firearm is fire-worthy or not. The test, however, must be carried with due safety measures.

In a murder case, the author received an improvised firearm along with fired cartridges recovered from the crime scene to find out if the latter were fired from the firearm.

The firearm had a jammed hammer, which could not be cocked. However, a blow on the hammer of the firearm could fire a test cartridge. The projectile charge from the cartridge was removed before firing. The marks on the test cartridges, thus obtained, matched with the marks on the crime cartridges. The accused was convicted.

The accused filed an appeal in the high court on the plea that the firearm was defective and could not be fired. The high court judge, himself a gun enthusiast, was intrigued when he saw the firearm. How was it test-fired, he could not decide. He, therefore, called in the author. The firing was demonstrated in the premises of the court after removing the projectile charge of the cartridge. (CH)

2.5 Accidental Discharge

The problem whether a given firearm is prone to go off accidentally assumes great importance in some cases to decide whether a particular incident is homicidal, suicidal or accidental.

Whether a firearm is prone to accidental discharge or not is determined by careful examination of the mechanism, the condition of the firearm, the ammunition and the circumstances of the case. They vary from case to case. No comprehensive/systematic guidelines are, therefore, possible. The following observations of some real cases, might initiate a critical appraisal of the circumstances of a shooting case to decide whether it is an accident or not.

1. Black powder (also called gunpowder), was the only propellant used in firearm ammunition in olden days. The propellant is still being in muzzle-loading firearms in India.

   The guns made for black powder ammunition cannot use ammunition containing smokeless powder, because the smokeless powder ammunition develops vastly higher pressures, which cause firearm bursts. For example, in modern rifles, the pressure developed is of the order of 3000 atmospheres (roughly equal to 3100 kg/cm^2). Old rifles were not manufactured to withstand such high pressures. If somebody uses modern ammunition in an old firearm, it may cause serious accident.

2. The mismatched firearm-ammunition combination may cause accidents. Sometimes a criminal or an amateur hunter modifies the available

ammunition (stolen/rejected/over-dated) to make it fire-worthy for his own gun. For example, rifle ammunition is modified for handguns. If it is done without proper knowledge, it may cause serious accidents. Sometimes the non-availability of proper ammunition forces a person to 'adjust' available/improper ammunition for use. The improvisation may cause accident and prove dangerous.

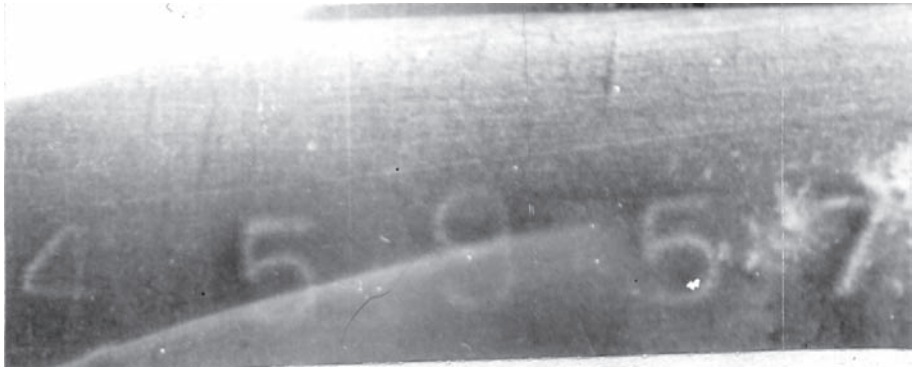

Fig. XVI-1

Damuscus barrel in a muzzle loader is prone to accident if smokeless powder is used.

3. The defective ammunition may cause accidents. Usually the defective ammunition is not common, unless it is homemade. The excessive powder charge, the oversized projectile, or the defective cartridge case may contribute towards the accident. The fired ammunition and the firearm are checked thoroughly to find out the defects if accident occurs.
4. In some countries, hunters often load their cartridges themselves. If the hunter is not sufficiently experienced, he is likely to make mistakes. Excessive powder charge, combined with other factors, may give excessive pressure, which can cause accidents.
5. The firearm may be old and rusted. There may be defects/cracks/nonaligned parts. The weakened areas deteriorate further with time/use/misuse. A stage comes when the firearm bursts to cause accident.
6. In revolvers, especially in country made revolvers, sometimes the chamber wheel and the barrel do not align properly. The alignment defects may develop due to wear and tear or accidental damage. The bullet may not pass through the barrel. It is stuck in the system. This may cause serious accident injuring the shooter, sometimes with fatal results. If the chamber and the barrel bore are even slightly misaligned, the bullet is shaved off. The shaved off chips may cause serious injuries.
7. If an over-sized projectile is fired through a firearm, it is stuck in the barrel. It may burst the firearm and cause serious accidents. Sometimes

the stuck bullet remains unnoticed. A second fire may burst the firearm.

8. If the powder charge is defective, it may not develop proper pressures. The result is that the bullet may remain in the barrel. A second fire from the firearm may cause a burst.
9. In the breech loading firearms, if the lever, which closes/opens the breach, does not function properly due to faulty manufacture/wear and tear/damage, the breech may open on firing and cause serious accidents. Improper locking of the breech, due to negligence, may also lead to accidents.
10. Defective trigger pull, in a firearm, has caused numerous accidents. The trigger pull cannot be made very heavy because a heavy pull affects the aim. It cannot be very light because it causes accidents. The trigger may be pressed accidentally and it goes off. The energy required for the pull may come from some obstruction, jerk or fall. The firearm manufacturers, therefore, take great care to ensure proper trigger pulls in their firearms. They also protect the triggers with trigger guards.

Table XVI-2

STANDARD TRIGGER PULLS OF VARIOUS FIREARMS

Firearm	Pistol	Revolver action		Shotgun barrel		Rifle	
		Single	*Double*	*Right*	*Left*	*Sporting*	*Service*
Inclination (in degrees)	45°	45°	45°	15°	25°	25°	25°
Trigger pull (in kg.)	1.36 to 1.81	1.36 to 2.27	7.26 to 9.07	1.59 to 1.81	1.81 to 2.04	2.27 to 2.72	2.72 to 3.18
Trigger pull (in 1bs.)	3-4	3-5	16-20	3½-4	4-4½	5-6	6-7

Trigger pull can be measured with a spring balance.

11. Another, important cause of accidents is the negligence about the safety devices. Frequently, a safety device is in the form of a lever, hidden or visible. It obstructs the fall of the hammer on the firing pin. The shooter neglects to set the safety device in a safe position when the weapon is not in use. The trigger is pressed accidentally and the firearm goes off.

Ordinarily, the firearm manufacturers introduce some safety margin in all the firearms, they manufacture. Even in muzzleloaders, there is a half-cock position stop for the hammer. It prevents accidents, while cocking. In half-cock position, even if the trigger is pressed, the firearm does not go off.

In firearms with hammer, the cocking process acts as a safety measure. The hammer has to be cocked before it can be fired. Nevertheless, accidents occur because the hammer is left cocked in a loaded firearm negligently, even when it is not to be used for some period. The gun goes off when the trigger is

pressed/pulled accidentally. Alternatively, a violent jerk to the firearm releases its hammer.

The children not knowing that the firearm is loaded may cause accidents while playing with loaded firearms.

In hammerless shotguns, there is invariably a safety catch, which is operated through a lever. In 'safe' (S) position, it blocks the hammer. In the other position, it allows firing.

Sometimes the safety catch does not function properly. It does not block the hammer when it should. When the trigger is pressed negligently, the hammer is released. It strikes the firing pin and the gun is discharged.

In revolvers, the heavy pull on the trigger provides the safety measure. Sometimes a lever placed near the trigger, hinders its pulling. In normal firing, the lever is moved away from the position.

> *In an accidental case, a revolver, kept in upholstery, while being handed over to a second person fell down, with the hammer hitting a hard floor from a height of about one metre. The weapon went off. The bullet hit the ceiling without injuring the two persons who were within inches of the flying bullet. (CH)*

In the automatic and the semi-automatic firearms, varying safety devices are used. The commonest safety device is a lever, which blocks the movement of the trigger in a way similar to the one mentioned above.

Sometimes an additional safety measure is provided in pistols. If the magazine is not in position, the firearm cannot be fired.

The most important aspects of the investigation of the allegedly accidental shooting cases are the circumstances of the accident. They should be understood thoroughly. The available evidence, the firearm, the ammunition, the scene, the clothes of the victim, the injury/post-mortem report, the photographs of the scene and the statements of the accused/victim/witnesses all help. The reconstruction of the events and virtual reality enactment are useful.[1]

2.6 Firearm Fired

Whether a firearm has ever been fired or not, can be found out from the GSR traces, which the firing process always leaves in/on the firearm. These traces are both metallic and non-metallic, visible even to the naked eye, most of the times and identifiable through chemical tests. The GSR fouling is washed off sometimes. Nevertheless projectile(s) scrapes remain in the barrel. The scrapes are not easily removed.

The chemical analysis of the scrapes identifies the projectile materials (lead, copper, etc.) confirming that the firearm has been used for firing.

2.7 Resuscitation of Serial Numbers

The criminals often file, erase or mutilate the numbers and logos on the firearms to hide the correct identity of the firearms. Sometimes they substitute them with new entities. It is possible, in most of the cases, to resuscitate the

1. Kindly see chapter 21 on '***Reconstruction***'.

original number, design, etc., which can identify and link the owner with the crime.

Some clever criminals inter-change important parts of weapon, barrel, action, etc., to mislead the investigation. Resuscitation of the correct number on the replaced parts reveals the fraud.

The numbers, logo and the designs are impressed upon a firearm under high pressure. The metal immediately underneath is compressed. There is, thus, greater concentration of metal under the impressed digits, letters, figures, etc. The various methods of resuscitations exploit this simple fact.

A figure is removed by filing, grinding, abrasion or by a combination of these processes. When the figure just disappears, the criminal stops the process. He feels that as the serial number is removed, the firearm cannot be linked to its owner. However, the latent images of the digits, letters or figures remain underneath the surface in the form of a strained area. The compressed sites react with chemicals at accelerated rates. The number, logo, etc. thus pop out. They are noted and photographed.

If the whole strained metal is removed by cutting, filing etc., the resuscitation processes will not succeed.

Most of the methods employed for the resuscitation involve application of chemical solutions. The solutions and their mode of application vary from one worker to another and according to the nature of the surface. The following solution gives good results with iron and steel:

Table XVI-3

Hydrochloric acid[1]	=	10 to 40 ml.
Water	=	25 ml.
Alcohol	=	30 ml.
Cupric chloride	=	2.5 to 5 g.

The surface bearing the data is cleaned and polished. It is then swabbed with the solution repeatedly. Alternatively, a wall, of modeling clay is built around the surface being etched to form a tank. The solution is poured in the tank. The surface is watched closely. The data is photographed, when it appears.

Electrolytic, magnetic and radiographic methods are also used to find out the numbers, words and logos, etc. Ultrasound, heating, and cooling methods have also been tried.

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1. Other etchants used are:
   a. Fry's Reagent.
   b. Turner's Reagent.
   c. Davis Reagent.
   d. 25 % Nitric acid.
   e. 10 % Sodium hydroxide.
   f. Ferric chloride.
   g. Acidic ferric chloride.

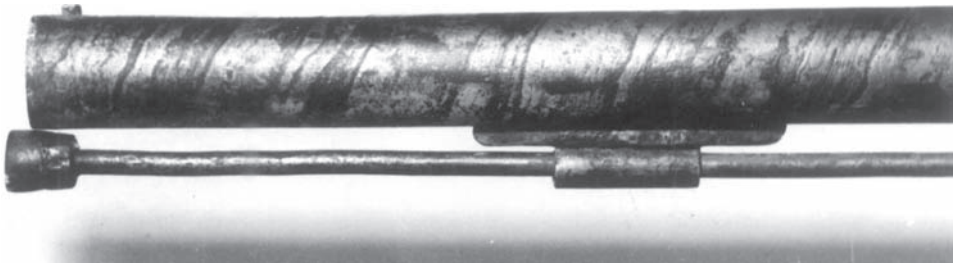

Fig. XVI-2

Damuscus barrel in a muzzle loader is prone to accident if smokeless powder is used.

3. AMMUNITION

Both live and fired (spent) ammunition is involved in crime situations. Both help investigations.

3.1 Live Ammunition[1]

The common questions asked about live ammunition are:—

1. Is the given item ammunition?
2. Is the ammunition fire-worthy?
3. What is the type/calibre of the firearm for which the given ammunition is intended/manufactured?
4. Who has manufactured the ammunition?

The propellant, projectile charge, primer and cartridge cases, collectively or individually, are called ammunition. Ordinarily, the live cartridges are termed ammunition. They permit easy identification from the legends they carry. Even the individual parts offer no difficulties for their identifications.

The determination of the calibre of the firearm, for which the ammunition is meant, is also not difficult to find out. It is found written on the head stamp of a cartridge case. Alternatively, the diameter (internal) of the cartridge case at the mouth, of the wad or of the bullet indicates the calibre of the firearm. Calipers and micrometers are used to measure the diameters/calibres. The calibres of firearms are nominal. The actual diameters are usually different.

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1. Ammunition is defined in law [Section 2(1)(b) of the Arms Act, 1959]. According to the Arms Act, 1959, Ammunition means: "Ammunition for any firearm" and includes:—
   (1) Rockets, bombs, grenades, shells and other like missiles.
   (2) Articles designed for torpedo service and sub-marine mining.
   (3) Other articles containing or designed or adapted to contain explosive, fulminating or fissionable material or noxious liquid, gas or other such thing whether capable of use with firearms or not.
   (4) Charges for firearms and accessories for such charges.
   (5) Fuses and friction tubes.
   (6) Parts of and machinery for manufacturing ammunition.
   (7) Such ingredients of ammunition as the Central Government may by notification in the official gazette specify in this behalf.

The determination of the fire-worthiness (or otherwise) of the ammunition crops up in old ammunition. The only reliable way to determine the factum is by actual firing. Ordinarily, the ammunition remains fire-worthy for years, if it is kept properly.

The manufacturers also give the fire-worthiness period of the ammunition.

3.2 Fired Ammunition

The fired ammunition has three components: the shell, the projectile and the GSR. All of them are important clue materials and facilitate investigation of shooting incidents.

A fired bullet helps the following determinations:—

(1) The diameter of the projectile.

(2) The number of grooves and lands.

(3) The direction of the twist.

(4) The width and the depth of the grooves.

(5) The angle of twist.

(6) Presence of extraneous matter.

The first three determinations are more helpful. They are frequently utilised to find out the make and model of the firearm used to fire the bullet. In practice it is, however, not always possible to identify the correct make or model of the firearm because:—

1. Cheap imitations of the standard firearm are often available in the clandestine market.
2. The manufacturer introduces changes in the specifications of the same make.
3. The wear and tear of the weapon and the damage change the marking profile of the firearm. They may mislead the expert to give incorrect identity of the make of the firearm.
4. The data compiled for the correct identification may be inadequate. (The data collected by Mathews (though dated) and by some others was/is helpful in this respect, in some cases).

The identification of the make of the fired bullet is established through dimensional and chemical analyses and comparing the results with those of the authentic samples. The exact dimensions and compositions of the bullets vary with different manufacturers. The following determinations of the projectile are helpful:—

1. Weight, dimensions,
2. Shape,
3. Gross composition, and
4. Trace elemental profiles.

These determinations, usually, indicate the manufacturer.

The presence of extraneous matter on the fired bullets and projectiles indicates that they have passed through an intermediate target or ricocheted from a surface. The nature of the material determines the nature of the intermediate target. Thus the presence of glass particles, wire mesh pattern, fabric pattern, presence of cloth fibres, wood particles, paint particles, etc., often link the target with the bullet. The following are some illustrative cases:

1. *In an interesting robbery case, the police had allegedly collected two projectiles, which had passed through thick wooden partition. The expert did not find any extraneous matter on the projectiles. The accused had allegedly fired shots through the wooden partition. The projectiles, therefore, should have traces of wood on them. The defence argued that as the prosecution expert did not find any wood traces on the bullets they could not be the 'crime' bullets. The police had planted them. The court accepted the argument and giving benefit of doubt to the accused, acquitted him. (CH)*
2. *In an attempt to control mob violence, the police, to frighten the mob, fired some shots in the air, upwards in the sky. However, a person was killed. The postmortem revealed entrance wound on the back. Obviously, the victim was hit from backside.*

   The victim's family claimed merciless killing by firing on the fleeing rioters. However, when the bullet was examined, it carried concrete material, indicating that the bullet had ricocheted from some structure. (CH)

In fired cartridges, as compared to bullets, the class characteristics are still less pronounced. They often do not lead to even a guess of the make and model of the firearm. For example, in 12 bore shotguns, the strikers and extractors of guns of different makes, are often indistinguishable, positionally. There are very few other marks. The total information does not lead to the manufacturer. However, the information is available on the case, in abbreviated form.

The identification of the manufacturer of the fired ammunition is required only rarely.

4. IDENTIFICATION OF THE SHOOTER

The gunshot residues (GSR) are deposited on the hands, face and clothes of the shooter. They permit identification of the shooter. The GSR deposits are more in a firearm with loose breech (revolvers!) or with short barrels.

In cases of suicide, the GSR are found sometime on both the hands, one is used for pressing the trigger, the other hand is used to steady the gun.

Many variables affect the identification of the person that fired the shot. The major variables are:—

1. The Nature of the firearm.
2. The barrel length.
3. The time elapsed since firing.
4. Propellant used.

5. Type of primer used.
6. Existence of prior barrel fouling.
7. Elimination/removal of the GSR intentionally or otherwise.
8. Injuries on the shooter in the firing process.

4.1 Nature of the Firearm

GSR is always emitted in the firing process, mainly from the muzzle and partly from the breach end of the firearm. The GSR particles are light and lose their velocity soon after coming into the atmosphere. They float in the air around the shooter. They settle down on the entities around the shooter, including on the person of the shooter. The amount of the GSR deposited varies for different type/make of the firearm/ammunition. The amount of GSR deposited on the hand of the shooter, thus, varies tremendously.

In the shoulder firearms, the hand of the shooter is away from the muzzle and the breech is, ordinarily, properly sealed. Consequently, the gunshot residue, which is deposited on the person of the shooter, is considerably less. However, if the weapon is defective and there is leakage from the breech end, more GSR may be deposited on the shooter.

It has been observed that in about seventy-five per cent. cases of shooting, where the handguns were involved, it was possible to detect the discharge residues on the hand of the shooter.

The quantity of the GSR now does not obstruct the detection or the quantification of GSR, thanks modern tools and techniques.

In country-made firearms, no regular experiments have been carried out, but the general structural features of the weapons suggest that the discharge residues should almost invariably be deposited on the shooter's hand, face and clothes in appreciable quantities.

4.2 Barrel Length

Most of the GSR is emitted from the muzzle end. It diffuses around in the atmosphere. It also travels backward and settles on the gun, on the shooter and on the object around. If the firearm is short-barrelled, greater amount of gunshot residues is deposited on the hand holding the gun.

4.3 Time Elapsed

The normal use of the hand, its movement, wind action and other activities of the shooter are likely to dislodge the gunshot residues from the hand. It has not been determined in how much time the GSR is dislodged from the shooter completely. Ordinarily, most of the metallic residues are lost in about six hours. Organic GSR may remain for about twelve to twenty four hours. Washing, wiping, etc. expedite the removal.

In cases of suicide, the gunshot residues should remain for a long time due to inactivity of the victim, unless removed or dislodged mechanically.

Identification of the gunshot residues on the hands helps to ascertain the nature of a given shooting incident, whether it is a suicide/accident/murder.

4.4 Propellant Used

The nature and amount of propellant determines the nature and quantity of the GSR formed and deposited on the hand. For example, black powder dense black GSR containing inorganic compounds mostly. GSR from smokeless powder is grayish and contains numerous organic compound components.

4.5 Primer Used

Primer compositions affect the chemical composition of the GSR. The modern primes contain antimony styphnate, barium peroxides, etc. They contribute metallic ions: Lead, Barium and Antimony. The trio is unique to GSR and even one particle of GSR with the trio identifies it as GSR.

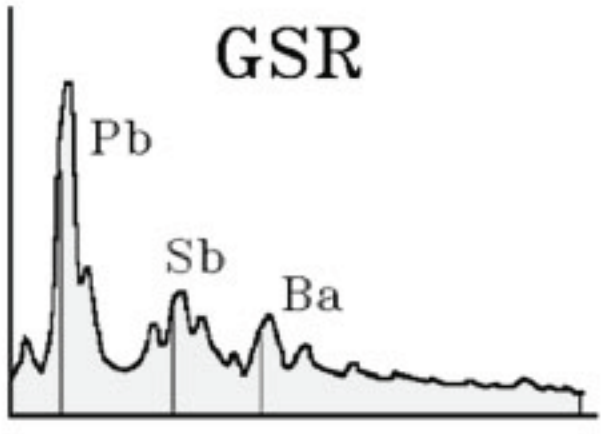

Fig. XVI-3

SEM trace of a particle confirms its GSR origin

4.6 Barrel Fouling

A badly (excessively) fouled barrel adds to the quantity and quality of the GSR. Excessive lead fouling of the barrel increases lead in GSR. Other constituents of the previous firing also add up.

4.7 Distribution of Gunshot Residues

The distribution of GSR is uneven on the shooter's hands. The richest source is the web of the hand between the thumb and index finger. The GSR amount decreases on the outer surface of the thumb, on the back of the index finger and on the outer surface of the hand and other fingers. Ordinarily, there is no deposit of GSR on the palmar surface of the hand. It may sometimes pick up GSR from surfaces bearing the same.

In the identification of the shooter, the topography of the hand is important. It is taken into consideration while collecting GSR.

The gunshot residues on the shooter come from:—

1. GSR escape from the breech end.
2. GSR escapes from the muzzle end.
3. GSR transference from surfaces bearing GSR.
4. Deposit of floating GSR in the air around.

The GSR, thus deposited, on the hands, face, hair, clothes, etc. help to identify the shooter or his presence close to the shooting site.

Theoretically, GSR metal elements can come from other sources also. However, the presence of the traces of trio elements barium, antimony and lead in a particle are unique to a GSR particle. If the particle is collected from the hand of a suspect, he stands identified as the shooter. Scanning Electron Microscope (SEM) identifies the trio. The races come from primer composition.

Other techniques used for fixing the presence of these trace elements are Neutron Activation Analysis and Flame-less Atomic Absorption Spectrometry.

4.8 Collection of GSR

The methods used to collect GSR are:

1. The suspected site is swabbed with cotton swabs moistened with ten percent hydrochloric acid or with five per cent. nitric acid.
2. The inert adhesives (on tape) are being used increasingly to pick up GSR from the hands (and other surfaces). The lifts are analysed. Adhesive tape lifters are quite convenient.

In some countries (*e.g.*, in UK), GSR kits are used, in which swabs, acids and the receptacles for the swabbed material (including the swab) are supplied to the investigators.

It is preferable to swab the entire hand and to collect the swabs area-wise. The separate areas are:—

1. Back of the hands.
2. Palms of the hands.
3. Palmar and back surface of the thumb, of the forefinger, and of the web in between.
4. Palmar and back surfaces of the other fingers.

Also *see* section 10.5.

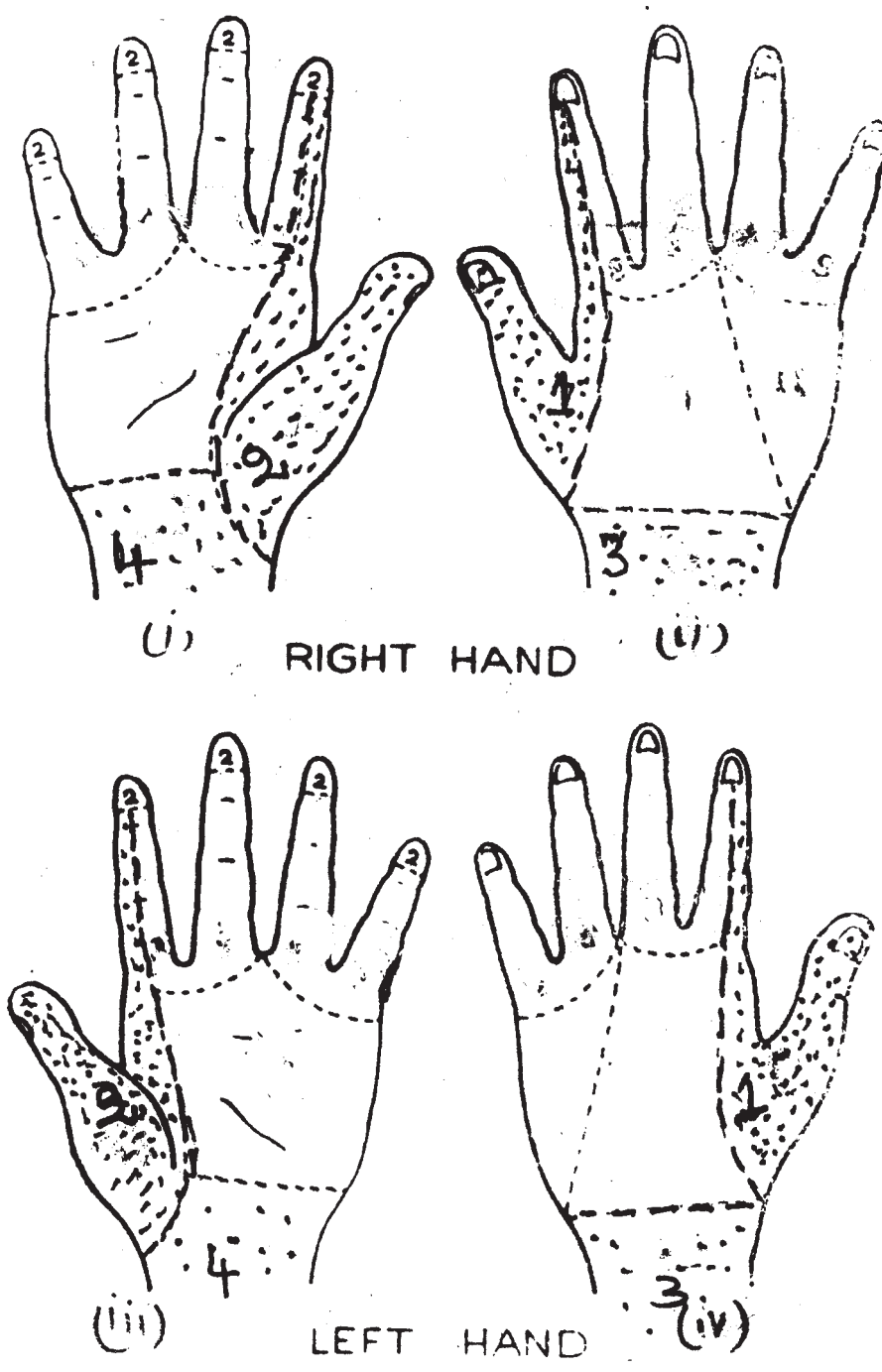

Fig. XVI-4

Powder patterns on shooters hand areas of maximum density are shaded. Swabs should be collected separately from different sites.

4.9 Detection

The detailed methods of detection, location, collection and evaluation of GSR deposited on hands, face, clothes and elsewhere have been discussed elsewhere[1] in some details. The same may be perused

5. MUZZLE-LOADING FIREARMS

The muzzle-loading firearms are still in use in some parts of India. They are licensed firearms, usually used by the rural people for the protection of their crops and animals against wild beasts. They crop up in the commission of crime. Sometimes they are involved in shooting accidents.

The investigations of shooting incidents involve the evaluation of the following evidentiary clues:—

5.1 Percussion Cap

The percussion caps, on firing, are blown into small pieces. In some cases, however, they may retain identifiable marks. The test percussion caps are fired, without powder and projectile charge. The hammer marks thus obtained, are compared with the crime exhibit in the usual way.

5.2 Projectile Charge

The homemade pellets/buckshots/balls are the projectiles used in muzzleloaders. The lead of the projectile charge is analysed for trace elemental profile. The result of the analysis is compared with the analysis of the lead recovered from the accused. If the trace elemental profiles correspond, they identify the common source.

If the projectiles are prepared in moulds by the accused at home, the mould marks, available on the incriminating projectiles are compared with the marks on the corresponding projectiles recovered from the suspect, or prepared as test projectiles from the mould recovered from the suspect.

> *A few years ago, a lead ball was recovered from the body of the deceased in a shooting case. It was a homemade ball. Some balls and a mould were recovered from the house of the suspect. The marks found on the incriminating ball, when compared with the marks on the sample ball, confirmed the common source of the crime and the specimen balls. (CH)*

Sometimes the incriminating projectile may carry the ramrod marks. Comparison of the marks with the test marks obtained from the ramrod may identify the common source of the marks.

5.3 Wads

Rags or pieces of paper are frequently used as wads in muzzleloaders. The wads fall at the scene of occurrence. Comparison of the rags or the pieces of paper with those recovered from the house of the suspect may indicate the common source of origin.

> *In a case of murder, the culprit had used newspaper pieces as wads. One of the pieces recovered from the scene fitted mechanically with the torn newspaper piece*

1. Kindly see chapter 13 on Gunshot Residues.

recovered from the house of the accused, connecting the accused with the crime. (CH)

5.4 Powder Charge

The black powder is used as propellant in muzzle-loaders, usually. The compositions of the powders vary only slightly with different makes and in different batches. The examination and comparison of the GSR recovered from the scene, and gunpowder from the suspect have, therefore, limited utility. However, comparison of the trace elemental profiles gives useful results in some cases.

6. FRAUDULENT MANIPULATIONS

The criminals have sometimes fiddled with the forensic ballistic evidence to hoodwink/mislead the investigations. The author has come across the following types of frauds relating to firearm evidence:

6.1 Filing

The commonest practice of the criminal, to mislead the investigation, is to file off the parts of the firearm, which imprint their thumbprint on the fired ammunition. The fired ammunition now, from the altered firearm has different marks. They often inhibit the linkage of the crime firearm with the crime-fired ammunition. For example, in shotguns, the firing pin marks are the only marks, which link the crime-fired cartridge with the firearm, in most of the cases. If the firing pin is filed. The original mark pattern is lost and linkage of the arm-cartridge is inhibited.

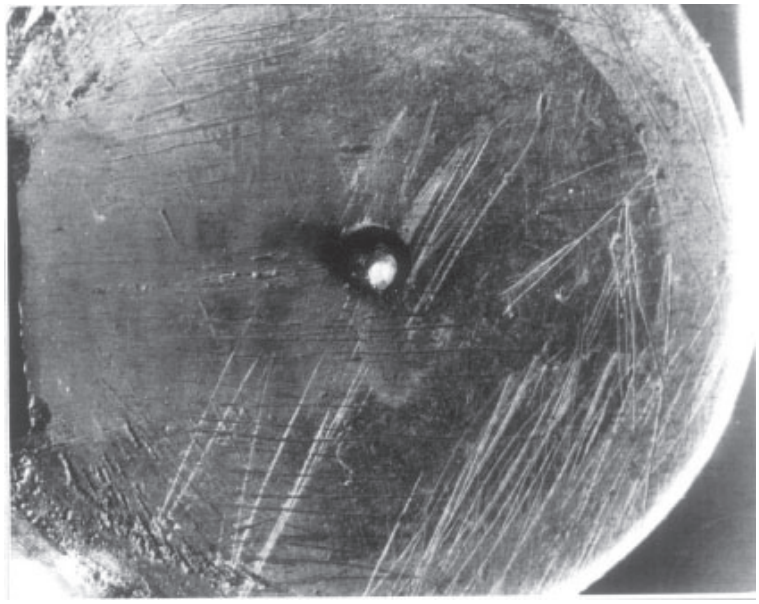

Fig. XVI-5

The firing pin of a shotgun was filed off. There were no other marks. The fired cartridge could not be linked to the cartridge. However, the mutilation of the firearm was established.

6.2 Acid Treatment

The acid treatment of the mark-creating parts of the firearm destroys/alter the surface characteristics. Thus, test ammunition fired from the acid-treated firearm will not carry the old set of marks. They will not permit comparison/identification/linkage of the marks on the incriminating fired ammunition.

In a case of murder, by shooting, the firearm received was apparently cleaned and oiled. The test cartridges revealed that they carried all the class characteristics present on the crime exhibits, but the individualising marks were different. The detailed examination of the firearm revealed that the relevant surfaces had been treated with acid. (CH)

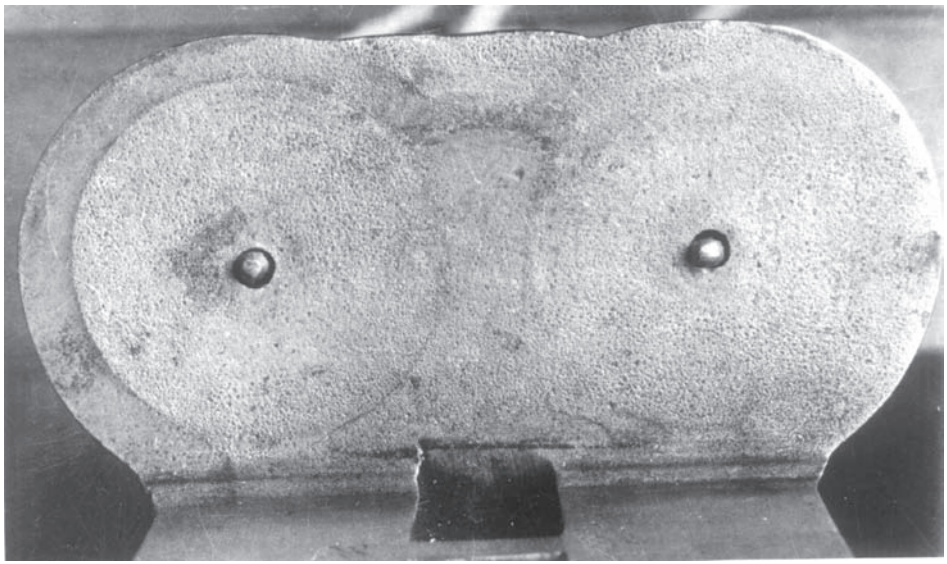

Fig. XVI-6

Acid treatment of the breech face and the firing pins changes the surface characteristics completely. The cartridges fired before and after the treatment often cannot be identified inter se.

6.3 Replacement of Part

The firearms produced on a mass scale, like the service rifles, have interchangeable parts. For example, in bolt-action rifles the bolt can be easily interchanged. The bolt is the main part, which imparts practically all the identifying marks to the cartridge case. The replacement of the bolt, therefore, can mislead the investigation.

In the improvised firearm, the parts can be replaced quite easily.

In a case received from border area, the guard on duty killed his officer-in-charge at night. Test firing pin and bolt head marks were obtained from the rifle, issued to the suspect, these test marks did not tally with those on the crime cartridges. The circumstances of the case were such that only the suspect could be the murderer. A detailed examination of the bolt head did not reveal any tampering.

Had he switched the bolt with that of the rifle of a colleague?

The accessible rifles to the suspect were examined. He had actually switched the bolt for killing the officer and then replaced the bolt to its original rifle. (CH)

6.4 Removal or Damaging of the Firearm Parts

It is easy to damage a firearm or to remove some part of the weapon to make it unserviceable. Thus, some culprits crush the barrels, some dislodged the triggers, some damaged action mechanism, etc. Often these changes make the task of obtaining the test ammunition difficult. It is rare, however, that they prevent the identification of the fired crime ammunition.

Besides, the destruction of evidence is an offence in itself, though not as serious as murder. The courts also draw adverse inferences: presumption of the guilt of the accused.

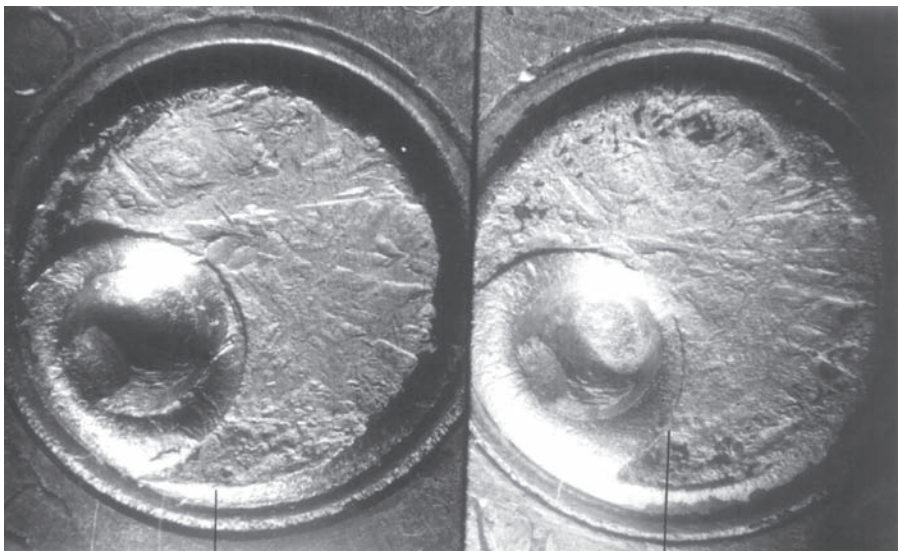

Fig. XVI-7

Filing of the firing pin alone did not help the culprit. Infallible breech marks pattern identified the common source of the crime (C) and test (T) cartridges.

6.5 Wrong Ammunition

The lower calibre ammunition fired from a higher calibre firearm can mislead an investigating officer. For example, if a fired .38 bullet is recovered from the dead body of the victim, it may lead the investigating officer to think that a .38 firearm has been used, whereas the culprit may have fired the bullet from a .45 firearm. He shall thus, waste effort and time in search of a wrong weapon. Likewise, the fired or unfired bullet can be fired from a shotgun by replacing the projectile charge of a standard cartridge with the misleading projectiles. They cause confusion.

In a case of murder, the victim was a person who had just been released from the jail. He was going towards his home when he was shot dead. The police apprehended the culprit, almost red-handed. He confessed to the murder and handed over a 12-bore gun and a fired cartridge to the police.

At the trial stage, the case took a dramatic turn. The accused alleged false implication. His counsel displayed the projectile extracted by the doctor. It was a .38 calibre bullet bearing well-defined groove and land marks. The police had failed to take notice of the same in view of the suspect's confession and motive, etc.

As the victim had been a notorious bad character, he had more than one enemy. The suspect had no previous police record. He was acquitted.

Did he use a fired .38 calibre projectile in the shotgun cartridge? It was suspected, not investigated/proved! (CH)

Some pistol cartridges cannot be used in revolvers of the same calibre because in revolvers rimmed cartridges are used whereas in pistols, rimless cartridges are used. However, there are devices (clips) by which the rimless cartridges can be used in revolvers. Even without the clips, the pistol cartridges may be kept in position with the help of a piece of paper or cloth. The possibilities of such misuse must be kept in view.

Some rimless cartridges can be fired from the revolvers as such.

Conversely, the rimmed cartridges have been used in the pistol or other firearms meant for firing the rimless or the semi-rimmed cartridges. Usually, the rims are filed off. The filed rims give away the fraud easily if the fired cartridges are recovered. It may not be possible to detect the deception from the bullets alone.

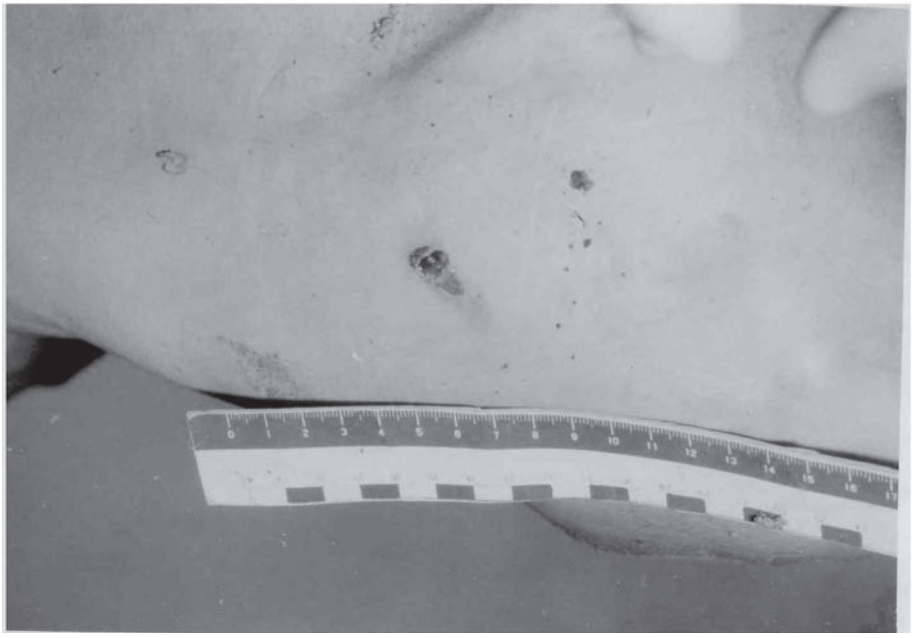

Fig. XVI-8

A novel mode to get away with a murder. A killer after removing the pellet charge from a 12 bore cartridge loaded with a .38 revolver bullet. He fired the cartridge and killed the victim. Later he claimed that he had no .38 firearm and did not fire the fatal bullet. He got away with the murder.

6.6 Multi-Ammunition Firearm

In a multi-ammunition firearm, the ammunition of different calibres is used. The number of such firearms is not large, but the variety is increasing. Some firearms can fire both centre-fire and rim-fire ammunition. Other firearms have different barrels for ammunition of different calibres, (say .22, .30, .315, .32, or .577). Some arms with large calibre barrel, take up a tube inserts of smaller calibre. For example, a rifled tube insert for a 12-bore shotgun makes it possible to fire bullets through the shotgun. If the culprit uses insert, it can cause confusion, especially if only the bullet is the incriminating evidence.

The inserts do not affect the identifying marks on fired shells. They carry the thumbprint of the firearm.

7. SPECIAL SITUATIONS

7.1 Damaged Cartridge Case

The fired cartridge cases may sometimes be damaged extensively in the firing process, especially when they are fired from improvised firearms. The percussion cap is pierced or it blows off. The shell may shred. Even in such situations, the identification is often possible because the fired shells are marked extensively. If the firing pin indentations are lost, the breech face marks may be available. If both are mutilated or absent, then the extractor marks may permit the identification of the firearm.

Caseless cartridges, as the name indicates, do not have a case. They, therefore, do not provide any cartridge case for the identification of the firearm.

7.2 Damaged Bullet

The crime bullets are often deformed and fragmented. Some portion of the bullet may be found undamaged. It may carry sufficient details to permit the identification of the firearm.

The high velocity, soft nose and expanding bullets often fragment. The bullets, which strike/pass through/embedded in bones, are damaged. They may retain identifiable marks, especially the jackets of the bullets. Lead bullets maybe too mutilated to retain identifiable barrel imprints in some cases.

The fragile bullets, used for gallery shooting and for stunning the animals, disintegrate or deform extensively on striking the target. They, ordinarily, do not permit identification of the firearm.

An under-sized bullet, for example, a .32 bullet fired from a .38 firearm, does not house properly in the barrel. Consequently, it is not marked properly. The identification of such a bullet is often not possible. In some cases, it may show identity of the common source, especially when it is compared with a pushed-through projectile of the correct calibre.

An over-sized bullet fails to revolve in the barrel of the firearm and often is stuck in the barrel causing accident. In some cases, if the over-sized bullet is made of lead, it may pass through the barrel. The marks on the projectile may give a look as if the bullet has been cast in a mould. The test bullets of the same calibre, if fired from the firearm usually carry similar marks. The firing of the over-sized bullets is a dangerous proposition.

The paper patch, wire patch and buckshots/pellets housed in a power-piston pouch do not pick up thumbprint of the barrel through which they pass. The firearm-projectile linkage, therefore, is not possible.

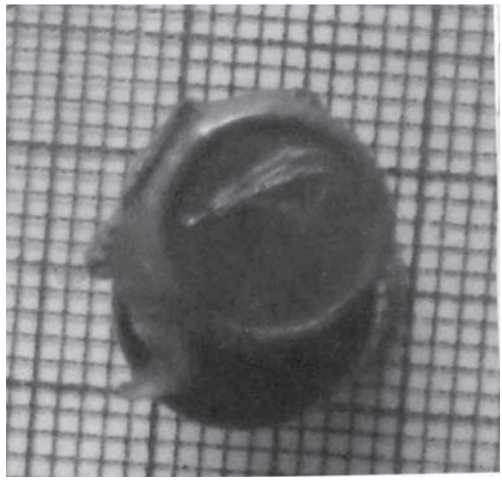

Fig. XVI-9

The base-cover of jacket, recovered from the victim and the fired cartridge case recovered from the scene did not match inter se. It exposed police padding.

In a case of murder, the medico-legal expert recovered a partially damaged jacket of a bullet from the head of the victim. The police allegedly also recovered a fired shell from the scene. They seized a pistol from a suspect and sent the three items to the departmental expert. He linked the shell with the pistol, but he could not link or delink bullet the jacket with the pistol in question.

The defence requisitioned the services of the author. He informed the court that the bullet jacket did not form part of the cartridge from which the fired shell had come.

Further on the suggestion of the author, the manufacturing manufacturer from Indian Ordnance Department of government of India was called for evidence. He confirmed the author's findings. His organisation has never manufactured bullets with such jackets! Apparently. The police padding was exposed. (CH)

7.3 Burnt Ammunition

The culprit may throw the cartridge case or bullet in the fire after the occurrence. If it does not melt, the marks may allow identification of the same. Lead bullets, ordinarily, lose identifiable marks if the temperature developed by the fire is above the melting point of the bullet (which it usually is) and if it had been in the fire for a sufficiently long time to melt it. The jacketted bullets and metal bases of the cartridges often retain identifiable marks.

In a suspected case of murder, the body of the deceased was cremated. The investigating officer recovered a lead mass from the ashes and sent it to the author. It was carefully studied. It was found that it originally formed a bullet. However, the falsehood of alleged natural death was eminently exposed. (CH)

In another case of murder, followed by arson, a burnt cartridge was examined. It was possible to identify the firearm, which had fired the cartridge. (CH)

7.4 Heavily Fouled Barrels

Rifled weapons firing lead bullet, scrape lead from the bullet and with passage of time, the deposits become quite thick, if the barrel is not cleaned regularly. The lead deposits interface with the markings on the new bullets fired from the firearm. They may not permit identification of the fired bullets *inter se,* as the pattern often changes due to some dislodgement of the deposited lead.

8. TIME OF FIRE

The time and date when a firearm, a cartridge or a projectile, involved in a crime was fired, has often important bearing on the investigation of the crime and in the reconstruction of the sequence of the events. The firearm is the most frequent exhibit for the determination, though fired shells and projectiles have been subjected to such determinations. The workers in the fields have, therefore, explored the possibilities of dating the fire. The success has, however, been limited, due to many variables including the following:—

1. The place where the exhibit is kept affects the time-bound changes materially. If a firearm is kept in the open, the exposure may bring about other changes and mask the time of firing evidence. If the exhibit is kept in a covered or closed place, the changes slow down. If the exhibit is kept in waterproof upholstery, the changes will be presumably still slower.
2. The atmospheric conditions greatly modify the time bound changes in the exhibits. Wind, rain, humidity and temperature are important factors. They must be taken into consideration if any intelligent guess is to be made about the time of fire.
3. The treatment given to the exhibit after its use/abuse is important. If the firearm has already been cleaned, oiled, washed, used or misused, the estimation of time of firing will be worse than worthless.
4. The variations in the ammunition due to different makes or different batches of the same make are inherent in the process of manufacture. The extent of the variations depends upon the manufacturer. These variables are always present. The expert considers them, in all experiments and estimations of time of firing.

8.1 Black Powder Residues

The black powder, on ignition, gives gaseous and solid residues.

1. The gases formed are carbon monoxide, carbon dioxide, hydrogen, nitrogen, methane and hydrogen sulphide.
2. The solids formed are potassium carbonate, potassium sulphate, potassium sulphide and potassium thiosulphate. In addition to these products, some carbon, iron sulphide and barium sulphide are also formed. Barium sulphate is formed only when barium nitrate is used in the gunpowder.

Hydrogen sulphide gives smell. However, the amount of the gas formed is too small to permit its identification by smell alone. Chemical tests are used to detect it.

A moistened lead acetate paper is exposed to the gas inside the barrel. It develops black colour due to the formation of lead sulphide. The gases disappear after some time. If the breech is not opened, they may last for 2 or 3 hours. If the breech is opened, it may vanish in less than five minutes.

The solid residue is black in colour to start with. The black colour is mainly due to the presence of iron sulphide. With passage of time the colour changes to grey, then to white, and, ultimately to brown. The white colour is due to sulphite and sulphate obtained from the sulphide. The brown colour is due to the formation of rust.

The barrel wash is light green to light brown in colour. There is a suspension of the black particles in the solution. The solution is alkaline.

If the powder contains excess of potassium nitrate, some of the nitrate may be left un-consumed. Thus, nitrates are detected in the residue, if the combustion is incomplete.

Ferric ions appear only with the lapse of time, usually after about a day. The nitrates appear after the disappearance of the sulphides.

8.2 Smokeless Powder

The gaseous products of the combustion of smokeless powder are carbon monoxide, carbon dioxide, hydrogen, nitrogen, and oxides of nitrogen. When the smokeless powder is burned, the solid residue is much less, than the solid residue obtained in the case of black powder. It consists of nitrites, nitrates, sulphate and carbon if graphite is used in the manufacture of the ammunition. The barrel wash contains sulphate, nitrate, nitrite and ferric and ferrous ions. Sulphate is not always present in the barrel wash. Even when it is present, it is in small amounts only.

Only *carbon monoxide* among the gaseous products has been used to find whether the firearm has been fired recently or not. For this purpose, the gases in the barrel of the firearm are sucked into silica gel impregnated with potassium-pallado-sulphite column. The original colour of the gel is light yellow. On the absorption of carbon monoxide, it changes to brown. The length of the coloured column indicates the quantity of the gas.

The test is useful only if it is performed immediately after the occurrence. The gas diffuses into the air within a short time.

Another time-variant factor discovered in gases is *nitrite/oxides of nitrogen.* If the gases in the barrel are tested from time to time, the quantity of the nitrite shows a gradual decrease with the lapse of time. It should indicate the time of fire.

The estimation of time from nitrite is only rough estimates because consistent experimental results could not be obtained in a series of experiments, even when the same firearm and similar ammunition were used.

Nitrites are also found in the barrel fouling, on the projectiles and in the cartridge cases. They decrease with passage of time but the variations in the

quantity are irregular/inconsistent. They do not permit fixing the time of fire with accuracy.

The quantity of nitrites is tested by colour development through diazo reactions or through UV spectrophotometer measurements. Nitrites give a peak at 210 to 212 nm at low concentrations. The quantity of the nitrite present at a particular interval is estimated from the colour intensity or the height of the peak.

8.3 Dust

It can be easily visualised that the quantity of dust deposited in the barrel will be a function of the time. It increases with the passage of time but the up-keep and weather conditions have profound effect on the quantity of dust. If the conditions of the up-keep are known, the amount of dust may give an idea of the time of fire. A freshly fired firearm should carry only fouling but no dust. Likewise, if the firearm is properly kept in a holster, the barrel may be free from dust, especially if it is capped or plugged.

The only conclusion one can draw from the presence of dust that the firearm has not been fired recently.

8.4 Mercury

Mercury fulminate was one of the important constituents of the cap compositions. When a cartridge containing fulminate is fired, mercury is deposited in the barrel. It evaporates slowly. Its quantitative estimations give some idea about the time of fire. The weather conditions and the way the firearm is kept, affect the results.

Mercury fulminate has been replaced in primers in INSAS ammunition in India and in some other countries. Mercury vapours are harmful to the life of the metallic cartridge case and cap composition. The latter deteriorates comparatively quickly and the former becomes brittle. Determination of time of fire from the presence of mercury is out.

8.5 Bloodstains and Flesh

The bloodstains and flesh are sometimes, found on the firearms in contact or near contact shots. The guess of the age of the stain/flesh, indirectly, indicates the time of fire.

8.6 Rust

If a barrel is not cleaned and oiled after firing, it starts rusting. The extent of rusting depends upon the nature of the steel, the GSR, the weather conditions (temperature and humidity) and the length of time the firearm has been rusting. The amount of rust may, therefore, permit a rough estimate of time of fire. The humidity and temperature of the atmosphere and the presence or absence of a catalyst, like potassium chloride, are taken into consideration in all these estimations.

In short, there are no reliable methods to ascertain the time elapsed since firing.

FIREARM INJURIES

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FIREARM INJURIES

1. GENERAL

The projectiles fired by firearms have certain shapes, velocities and kinetic energies, which differ from most of the other agents causing injuries. The shapes of wounds, the destructive effect on the tissues, presence of foreign bodies (of specific shapes and compositions) and the projectile track help to identify whether the given injury is a firearm injury or not.

The firearm injuries have usually three parts:

1. An entrance wound,
2. An exit wound, and
3. An internal track wound.

Most of them are highly characteristic. If they all are present on the body, connected *inter se*, they are usually firearm injuries. Individually also they carry enough evidence to indicate they are firearm injuries in most of the cases.

If the kinetic energy of the projectile(s) is consumed in creating the wound, there is no exit wound. The projectile settles down in the body.

A projectile may also create non-characteristic firearm injuries like graze, cut or contuse the site of impact, sometimes. Such injuries may not look like firearm injuries.

Their identifications do not offer serious problem most of the time. Extraneous materials in/on the body and the characteristic wounding phenomena help to identify them.

Extraneous/foreign mater (projectiles, their fragments, wads, GSR, etc.) deposited in/on the victim is characteristic and indicate firearm injuries.

The characteristic damage includes burning (also known as singeing, charring or scorching), abrasion contusions, through and through wounds and characteristic wounds like, ragged wounds, rat-holes, etc.

The medico-legal experts know the wounding phenomena. Other concerned like the IO, the prosecutor, the judge, the public are not well versed with the injuries. The ignorance creates confusion and affects justice. They, therefore, have been discussed concisely in this chapter.

1.1 Possibilities

The medico-legal evaluations of injuries indicate:

1. If the injuries are firearm injuries or not.
2. If the injuries are from one or more than one firearm.

3. If the injuries are from the alleged firearm(s).
4. Whether a particular injury is entrance or exit wound.
5. Whether the injuries, individually or collectively, are fatal or non-fatal.
6. Whether the injuries are ante-mortem or Post-mortem.
7. Whether the injuries are from one or more firearms.
8. Whether the deceased/injured could perform the alleged acts after receiving the given injuries.
9. Whether the injuries were caused from the alleged distance.
10. The age of the injuries.
11. The sequence of events.
12. The number of shots fired on the victim.
13. How long the victim survived after receiving the injuries.

Some medico-legal expert may also give the type of firearm used in the incident from the dimensions of the injuries and the damage they caused to the victim.

2. IMPORTANCE

The identification of firearm injuries and evaluation of their nature are important as well as necessary. The following cases examined by the author indicate the necessity of identification of firearm injuries:—

1. *In a case of murder trial, a number of injuries were found on the thigh of the 'victim' who had allegedly killed the deceased in self-defence. The injuries were circular holes, 3 mm in diameters and about 1-2 cm deep. The medico-legal expert did not find any projectiles (pellets) inside. The pellets had allegedly bounced out of the holes after striking bone. The court confronted the author the above 'facts' of the case and asked if the pellets could bounce out from the injuries. The author informed the court that the projectile could not bounce out if the pellets had traversed one to two centimeter in body flesh because the projectile would lose most/all of its kinetic energy and would have insufficient/ no kinetic energy for bouncing back. Further, the elasticity of the skin/flesh would inhibit its retracing the entry path. The possibility of these injuries being caused with an ice pick (or similar device) was suggested.*

   The court did not believe the self-defence story and convicted the ***'victim'*** *culprit for murder. (CH)*

2. *In a murder case, the doctor recovered two projectiles from forearms of the self-proclaimed 'victim'. The police sent them to the author to find the type of firearm from which they were fired.*

The examination revealed they were buckshot of the SSG size, fired from a 12-bore shotgun.

The astounding finding about the projectiles was their deformations. Each projectile had six flat surfaces, in three sets of parallel surfaces. That is, each pair had two parallel surfaces. It could happen only if the projectiles were hammered at three sites! The deformation could not take place in the barrel of any firearm in real firing situation.

The court accepted the findings that the projectiles/injuries were fake and convicted the 'victim' for perjury. (CH)

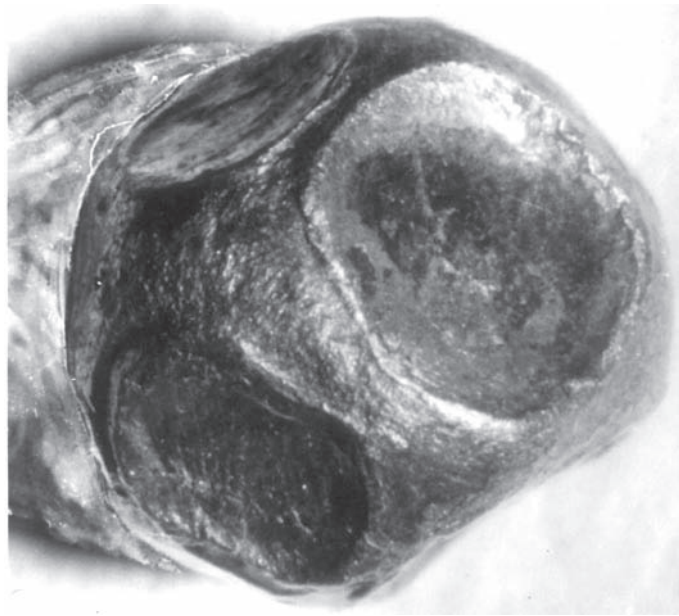


Fig. XVII-1

Three flattened surfaces visible.

The discovery of three parallel corresponding surfaces revealed the fraud.

3. *Some years ago, a culprit faked an injury on his person and produced himself before a doctor. The doctor after examining the injury extracted a buckshot. He informed the police. They registered a case for an attempt to murder against an unknown assailant. After a few hours, the police found a dead body in the same village to which the first 'victim' belonged. The inquiries led the police to the fact that the deceased and the 'victim' were dead enemies.*

   He recovered projectile was sent to the author for examination. It was found that the buckshot extracted from the injured had no deformation. It had no nitrite ions! Obviously, the projectile had not been fired from any firearm.

   It appeared that the 'victim' probably was finding a foolproof alibi for the time of murder, which he had committed. It proved true. (CH)

4. *In a multi-murder case, the convicted persons filed an appeal on the plea that the eyewitness on whose evidence they were convicted, was not present at the scene. The prosecution had proved his presence through firearm injuries, which he had allegedly received at the scene.*

   The doctor had extracted some 'pellets' from the wound. The extracted matter proved to be sand and grit only. The injury was probably fake. The High Court acquitted the convicted persons. (CH)

3. EXTRANEOUS/FOREIGN MATERIALS

The extraneous deposits include blackening, tattooing, dirt ring and the presence of the wads, projectiles/their fragments or materials picked up by the projectile from the intermediate target, if any.

The sources of these extraneous deposits are:—

1. **Propellant:** Combustion gases, smoke, semi burnt and unburnt propellants.
2. **Primers:** They induct trace elements in the GSR.
3. **Additives:** Stabilisers, oxidizers, etc. Over 20 organic compounds, which are used as additives in ammunition. They give Organic GSR.
4. **Projectiles**, cartridge cases, barrel (bore scrapings)/barrel fouling.
5. **Intermediate targets**, including the clothes of the victim through which the projectile(s) has passed.
6. **The surface** from which the projectile has ricocheted.

The extent of extraneous deposit depends upon:—

1. The firearm.
2. The ammunition.
3. The range.
4. The angle of fire.
5. The target characteristics.

Extraneous/foreign materials, foreign to the person of the victim and related to Forensic Ballistics, identify firearm injuries and provide useful information about the shooting incidence as discussed above.

3.1 Carbon Monoxide (CO) Pink Coloration

If a shot is fired from a very close range or in contact with the skin, some carbon monoxide (CO) (produced in the combustion of propellants) is absorbed by the skin and flesh. It gives pink coloration to the skin around the wound, which indicates that it is a firearm entrance wound from a close range.

The following facts about CO colouration are noteworthy:—

1. The presence of carbon monoxide is significant; its absence is not significant. Whenever CO is detected, a control sample from a distant tissue is also tested.
2. The coloration is masked by the colour of the skin or blood. Chemical test will reveal CO absorption.
3. CO can be detected by using gas chromatography.
4. In contact and near contact range wounds, CO is found absorbed in the body tissues along the track. Sometime it reaches the exit wound also.
5. Unburned propellant and carbon monoxide can reach the exit wound, though smoke (burnt powder residue) may not.

3.2 Charring

The charring (also called scorching, burning, singeing, etc.) is the burning effect of flame or hot gases produced in the combustion of propellants. The charring is caused is a close range phenomena. The size, shape and extent are characteristic of the firearm, ammunition and range.

The charring is often confused with the blackening, tattooing, dirt ring or even with the contusion ring. They are described as charring erroneously. The charring is different from the blackening. The latter can be removed with a cotton swab moistened with spirit while the former cannot be removed in this way. Careful visual and microscopic examination discriminate it from other phenomena.

Projectiles do not cause charring because they are not very hot (~100^0 C) and as they are moving at high speed, the skin-projectile contact time is not even a fraction of a second.

3.3 Blackening

Smoke particles deposits cause blackening. The particles are light. They do not travel afar. They deposit on the target to cause blackening. The range is short. All types of propellants in the ammunition, including smokeless powder, give smoke. The colour of the smoke is grey to black in black powder and light grey to dark grey in smokeless powder.

Blackening does not mean intense black deposits.

In a murder trial, the defence counsel cashed upon the ignorance of a medical witness. The medical officer found blackening around the wound, which he believed, to have been caused by black powder (and not by the smokeless powder). He stated accordingly. The cartridge involved contained smokeless powder. The author also appeared as witness in the same case. The defence asked only one question:

"Did the crime cartridge contain smokeless powder?"

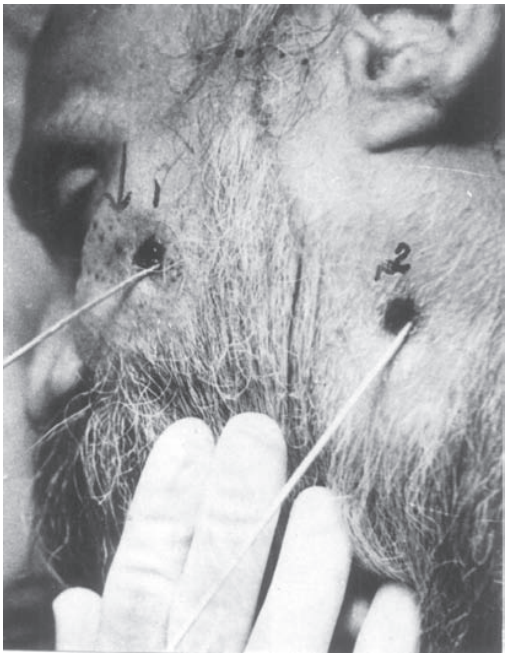
The author replied that the crime cartridge contained smokeless powder.

The counsel for the defence argued before the trial judge that a cartridge containing black powder caused the injury. The crime cartridge case, allegedly recovered from the scene and produced in the court, contained smokeless powder. The suspect, therefore, could not be the culprit. He got acquittal for the accused from the trial judge.

The state went in appeal. The high court called the author for expert help. It was shown experimentally that the blackening was caused by the cartridge of the same make (and batch) containing smokeless powder from the alleged distance, even when the target was covered with the clothes worn by the victim at the time when he was shot dead. (CH)

3.4 Tattooing

The tattooing is also known as peppering or stippling. It is the deposit of un-burnt or semi-burnt powder particles under the skin. Tattooing, ordinarily, cannot be removed with a swab.



In USA shotgun ammunition with buckshot charge, contain granular polythene white material as filler. This filler material is also projected on firing. It hits the target up to a range of 6 to 8 metres. Like powder particles, it also causes peppering and unless carefully examined, it can mislead the unwary. He can mistake it for powder tattooing. The pattern size of this peppering depends upon the size; shape of the particles and on the range. However, the pattern can be distinguished from the real tattooing.

Fig. XVII-2

Blackening and tattooing can be seen around the injury (1) indicated by the arrow head. There is practically no such phenomenon around the injury (2). The difference indicates that injury (1) was from a closer range.

3.5 Dirt Ring or Wipe Ring

Some projectiles deposit dirt around the wound. The materials come from:—

1. The projectiles may carry grease on them. The dirt gets collected on the grease, which is deposited around the wound when such bullets enter the body.
2. The bullet wipe ring is mainly due to the deposit of soot/GSR deposited on the bullet in the firing process. The edges of the entrance wounds scrape off the same when the projectile enters the target.

   The projectiles pick up the soot/GSR from the powder ejecta, which rush past the projectiles inside or outside the barrel. The wipe ring is mainly found on the primary (the target hit first) entrance hole. It may or may not be found on second entry hole. The lead bullets may also leave lead deposits in some cases. The wipe ring identifies the entry wound.
3. The projectile may pick up dirt while passing through an intermediate target (clothes, mud walls, etc.), or from the surface from which the projectile has ricocheted. This dirt deposit around the entrance hole is the dirt ring.
4. In shotgun ammunition, the pellets and buckshots are rubbed with graphite. The projectiles carry a small amount of the graphite and deposit it around the hole when entering the target.
5. The lead bullets may also blacken the edges of the entry wound.

The existence of a dirt ring indicates the entrance wound of a firearm injury. It is no guide to the range of fire.

3.6 Foreign Material

The projectiles or their fragments and sometimes the wads are found inside the body. Their presence not only confirms that the injury is a firearm injury but they also indicate the nature of the firearm used.

> *In the Kairon murder case, a former chief minister of Punjab and three others were murdered. The culprits could not be traced for some time. In the meanwhile, the nature of firearms used was ascertained from the foreign material (projectiles and their fragments) recovered from the victims. The culprits had used a .32 revolver, a .38 revolver, a .30 rifle and a 12-bore shotgun. (CH)*

3.7 Contusion

The impact of a projectile contuses the edges of a wound. The colour of the contusion varies from reddish dark to bluish black. It varies with the age of the injury, site of the impact and the force of the impact. The contusions are in the form of a band around the wound and are often of uniform width. They are identified by microscopic examination. The tissues are ruptured and swollen (extravasation!). There may or may not be any extraneous deposits.

3.8 Characteristic Wound

The characteristic nature: through and through wounds, ragged wounds, rat holes, explosive wounds, and key hole wounds allows, in most of the cases, the identification whether they have been caused by firearms. The details are available in the forthcoming chapters.[1]

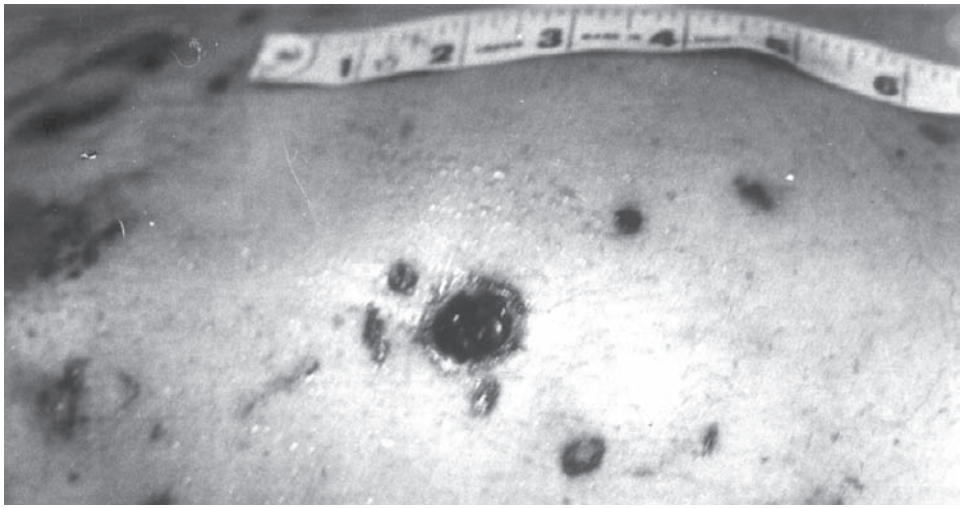


Fig. XVII-3

A 12 bore shotgun injury from over 2 metres. A rat-hole surrounded by small individual holes. This is a typical injury formed by a 12 bore shotgun from about 2 to 8 metres.

1. *See* chapters 18 to 21 of this book.

4. ENTRANCE WOUND

The prominent features of the entrance wounds, utilised for their identifications and evaluations, are:

1. The wounds are circular or oval, in most of the cases. Exceptions are there:
   a. The re-entry wounds may not have circular/oval shapes.
   b. Some entrance wounds are star-shaped, with tears of the skin, emanating from the edge of the entry wound, extending to 3-4 mm. The nature of the site and the firing range determine the emergence of such injuries.
   c. The palm, sole or elbow may not have standard shapes.
   d. Wobbling/tumbling/unstable bullets cause keyhole entry wounds because the bullet strikes the target length-wise, instead of nose-on position.
2. The diameter of the entrance wound is, ordinarily slightly less than the diameter of the projectile creating the hole. However, it is not always so. In some cases, it can be equal and in some, it can be larger.
3. The entry wounds have usually inverted edges; i.e. the edges are turned inward. In rare cases, it may not be so and in still rarer cases, they may be everted (turned outward) margins. Everson of the edges takes place only when ejecta/body materials come out of wound and push the edges outward.
4. Some entrance wounds have dirt or wipe ring. The material deposited is the dirt on the projectile or picked up from the intermediate target.
5. An entrance wound may have an abrasive collar. The rotating bullet, passing through the skin, abrades the skin/flesh from the entry site to give abrasion collar.
6. An entrance wound may have a contusion ring around the entry hole. It is found around the wound most of the times. The ring, is dark red to bluish-black depending upon its age. It permits identification of the entry wound where the inversion of the edges may not be clear. The contusion ring is caused by the impact of the entering projectile. The width of the contusion band varies, depending upon the site and the velocity of the projectile.

   The ring is not seen on palmar surface of hands and feet.
7. GSR deposits are from close range firing only. They identify the firearm entrance wound, whenever they are available.

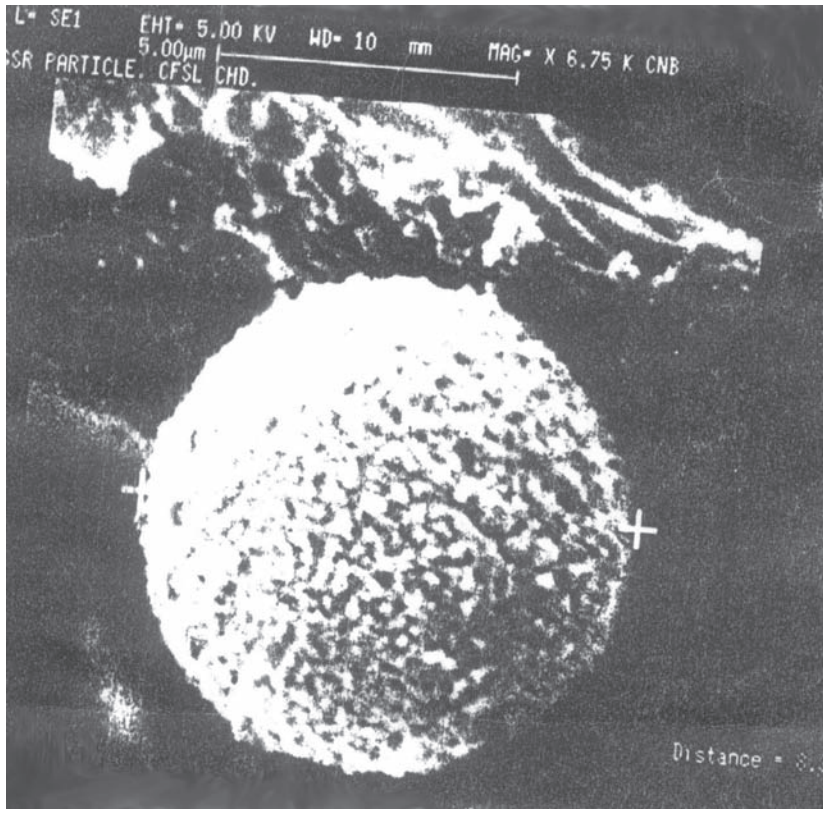


Fig. XVII-4

GSR detection through SEM. Magnifications around 7000X.

8. Sometimes the bullets carry GSR in their flight from the ejecta, from the barrel fouling and deposit it on the edges or inside the entrance hole. These GSR particles indicate entry wounds.
9. The presence of a muzzle impression around a wound indicates an entry wound.
10. The presence of pink colouration around the wound is due to the absorption of carbon monoxide. It takes place only around the entry wounds in close range firing.
11. The presence of wads in the wound may indicate that it is entry wound.

    The everted/inverted edges of the projectile holes in the bone or pattern of radial fractures also help in some cases.
12. Hot gases/flame from shots fired from close range cause burning/ scorching of the skin, flesh or singeing of the hair. A hot projectile does not cause burning, etc. because the maximum temperature, the projectile reaches, is around 100°C and the contact time with the skin is around one thousandth of a second. (1 milli-sec).

The phenomena when present, identifies the firearm entry wound.

Singeing of hairs also indicates firearm entry wound.

The difficulty of ascertaining the entry wound arises in some explosive wounds where the body part hit is blown off. The wounds created by some improvised firearms may also inhibit the identification of entry wounds.

The characteristic damage includes burning (also known as singeing, charring or scorching), abrasion contusions, through and through wounds and characteristic wounds like explosive wounds, ragged wounds, rat-holes, etc.

5. EXIT WOUND

All exit wounds have, irrespective of the range of firing, the following general identifying features:

1. They have no fixed shape or size. They can be circular, oval, slit-like or even star-shaped. Usually they are larger than the entry wounds and are irregular. They do not correspond to standard shapes.

   This is due to fragmentation and deformation of the projectile and changed projection area due to enhanced yaw in the denser medium and the body material it may carry along in the front. The main determiners are the velocity of the projectile, its shape and size and its structure (expanding/nonexpanding) type the shape and size of the exit wound. The site of the exit wound also influence its size and shape.
2. The eversion of edges and the direction of the pushed or pressed out flesh, indicate the exit wounds.
3. Sometime the projectile may have just sufficient energy to enter the body but not sufficient to exit. The projectile is entangled in the exit wound; obviously indicating the exit wound.
4. The location of the embedded bullet (in a wall) or its exit through a door or window can indicate the direction and hence the entry and exit wounds if the position of the victim, at the time of fire, is known.
5. If the entry wound is established and a probe through this wound comes out of another wound, the latter is obviously an exit wound.
6. The negative findings of the entry wound indicators of a firearm injury points towards an exit wound.

5.1 Shored Bullets Wounds

The phenomenon of 'shored bullet' is not common, but it does take place, though rarely. If the body surface from where the projectile is to exit, is pressed against a hard surface (a wall, a rock). This hard surface may push back the bullet into the body instead of going out. Such a projectile is called 'shored bullet'. This occurrence may cause:—

1. Contusion on the skin, like one due to impact on the skin.
2. The bullet may ricochet and cause another wound in the body.

3. The bullet may retrace its path to a certain distance and is lodged at that site of the body.

The phenomenon of shored bullet can occur only in high velocity and comparatively stable non-expanding projectiles. The projectile must have sufficient remaining striking energy after traversing the body part and does not break up inside the body.

6. INTERNAL INJURIES

A projectile in motion causes internal injury/damage to the body after creating an entrance hole. The kinetic energy of the projectile transferred to the body tissues cause the damage. Greater the kinetic energy transferred by the projectile, greater is the damage. The extent of damage also depends upon the body part which is hit. Kinetic energy (KE) of a projectile is given by the formula**:**

$$KE = \frac{1}{2} MV^2$$

[where m is the mass of the projectile and v is the velocity of the projectile]

If a projectile does not exit the body, then all its kinetic energy is transferred to the tissues. If the projectile exits the body (through and through injuries), then the kinetic energy transferred is:

$$KE = \tfrac{1}{2}\ M\ (V_1 - V_2)^2\ ;$$

[v_1 and v_2 are Striking and Remaining velocities of the projectile]

In wounding, the following facts are noteworthy:

1. **Velocity and mass**

   Velocity and mass of the projectile are the main determiners of the extent of wounding.

2. **Rate of transfer of kinetic energy**

   The rate of transfer of kinetic energy to the tissues is another determiner. The structural features of the projectile and the resistance offered by the tissues at the target control the rate. For example, a streamlined bullet may pass through the tissues without causing much damage to the body.

3. **High velocity projectiles impart momentum to the tissues**.

   The tissues vibrate and continue to vibrate even after the passage of the bullet and, thus, tear off tissues and create a temporary cavity. The location, size and the temporary cavity depends upon:

   a. The amount of kinetic energy transferred by the bullet.
   b. T rate of transfer of the energy.
   c. The tissue structure at the site.

4. **Wound Formation**

   All low velocity projectiles cut and lacerate the body tissues as the pass through them. No temporary cavity formation takes place and hence tissue damage is confined to the permanent cavity and to its vicinity

only. High velocity projectiles, in addition to the cutting and laceration along the permanent cavity create temporary cavities:

a. The cavity may be up to 30 times the diameter of the projectile
b. It last for 5 to 10 milli-seconds[1].
c. The developed high-pressures (~100 – 200 bars) create pulsations. The resultant damage to the tissues is extensive.
d. The diameter of the resultant permanent cavity formed is usually larger than that of the bullet.
e. It has a wide zone of haemorrhage around a small permanent cavity.
f. The tissue damage is greater than it appears in the postmortem.
g. High pressure may disrupt/burst the organ and form a large permanent cavity.
h. Dense and inelastic organs suffer greater damage.

5. Hydrostatic/hydraulic shock

Hydrostatic/hydraulic shock is based upon Pascal's law of transmission of fluid Pressure. It states:

> "A pressure change occurring anywhere in a confined incompressible fluid is transmitted throughout the fluid such that the same change occurs everywhere"

A penetrating projectile can produce remote wounding and incapacitating effects in living targets in liquid-filled tissues due to hydrostatic/hydraulic shock. It is due to the transfer of kinetic energy of a bullet through a shock wave.

Hydrostatic/hydraulic shock wave damages body in many ways:

(1) Disrupts the physiologic functions of the body, especially of the circulatory or nervous systems.
(2) Causes mechanical shock.
(3) Produce remote neural damage and cause incapacitation quickly.
(4) A fatal/grievous injury to the lungs, chest and abdomen can cause brain haemorrhage[2], caused by sudden changes of the intravascular blood pressure because of compression, believed to be due Hydrostatic/hydraulic pressure of the bullets.

A shock wave is created when an explosive or a high velocity projectile rapidly displaces the body fluids. Tissues behave almost like water. A bullet impact, which generates pressures in excess of 1,500 psi, can create pressure waves that can damage distant organs.

The researches on the effect of hydrostatic/hydraulic shock are still going on.

1. Milli-second is 1/10000 second.
2. An 8-month study in Iraq performed in 2010 and published in 2011 reports on autopsies of 30 gunshot victims struck with high-velocity (>2500 fps) rifle bullets. In all 30 cases, autopsies revealed injuries distant from the main wound channel due to hydrostatic shock.

7. POST-MORTEM/MEDICO-LEGAL EXAMINATION

The post-mortem/medico-legal examinations are done in government medical institutions. Usually the medical officer of a government hospital in the jurisdiction/locality where the incident has taken carries out the work. Most of the doctors, who do the examination, do not possess the necessary expertise. They are unable to do justice to this important work. The cause of justice suffers because of these unskilled doctors who do not possess sufficient expertise. However, the authorities are trying to remove the lacunae.

Medico-legal experts are available in most of government medical colleges having Forensic Medicine Departments. In addition, there are a few medico-legal institutions. These institutions have taken over some of the work. In some metropolitan cities, police surgeons carry out work. They are properly qualified for the work. However, more experts/institutions are needed.

7.1 Importance

The post-mortem and other medico-legal examination in shooting case is an extremely important. It helps to:—

1. Fix the *corpus delicti.*
2. Ascertain the cause of death, etc.
3. Find the nature of death: was it suicide, accident, homicide or killing in self-defence?
4. Identify the type of firearm used.
5. Ascertain the number of weapon(s) used.
6. Ascertain the number of shots fired at the victim(s).
7. Determine the direction of fire.
8. Prove/eliminate the existence of other crime (sexual assault!).
9. Confirm or discard the given versions.
10. Collect identification data of the victim, in the case of an unidentified body.
11. Collect evidentiary clues: projectiles, GSR.
12. Ascertain nature of injuries, damage, etc.
13. Fix the fatal/non-fatal nature of the injury.

7.2 Basic Steps

Medico-legal expert, in post-mortem examinations in firearm injury cases, follows the following pattern:—

1. He carries out the post-mortem examination in the mortuary only.
2. He studies the case history.
3. He visits the shooting scene whenever possible. Otherwise, he critically evaluates the documentation (photographs, video film, sketches, description, etc.) of the shooting scene done by the investigating officer to understand the mechanics of the occurrence.

4. He photographs the deceased, for identification purposes, before and after cleaning the body. He covers the facial features, identification marks like tattoo marks, any deformity/peculiarity, clothes, etc. The detailed photography helps in the case of unidentified and putrefied bodies.
5. He ensures no fingerprinting or embalming is done before the post-mortem examination – important trace evidence can get lost and the artefacts can get inducted, which can mislead.
6. He ensures the protection of the trace evidence (GSR, fibres, dust, etc.) while handling the body to the mortuary. If there are GSR traces on the hands, covers the hand with clean paper or preferably with a clean plastic cover.
7. He X-rays the body (relevant body parts) before starting dissection etc. for locating the projectiles or their fragments.
8. He photographs all the injuries before and after cleaning them, along with a scale and identity chit.
9. He ensures that the clothes of the victim and evidence (GSR, holes) thereon are preserved.
10. He examines the clothes as part of the post-mortem examination. He marks them for later identification.
11. He recovers all projectiles, GSR, etc.
12. He identifies the entry wound, the exit wound and the internal injuries concisely, precisely and intelligibly. He establishes their inter-relationship.
13. He does not use medical terminology in writing the post-mortem report and describing injuries and their site.
14. He records the negative evidence also.
15. He includes ballistics expert in the team carrying out the post-mortem, whenever possible.

7.3 Examination

A post-mortem examination in a shooting case involves the following major steps:—

1. General Examination

General examination should:

a. Fix the age, sex, race, body build, height, etc. of the corpse.
b. Note and record deformities, oddities, scars, old injuries, tattoo marks, moles, etc., if any.
c. Describe clothes on the person of the deceased: their number, nature and the evidence thereon.
d. Link the projectile holes on the clothes with the injuries on the person of the deceased.

e. Collect and preserve any evidence like GSR, fibres, hairs, stains, dust, dirt, etc. found on the clothes.

f. Check the clothes for any tears and holes.

g. Pack the clothes after drying if they are wet.

2. Body Examination

a. Observe and describe the degree and extent of lividity and rigor mortis found in the body or in any part of the body, if any.

b. Locate and describe any oddity on any part of the body.

c. Check and describe signs of asphyxia, if any.

d. Find and describe any dental/denture oddities.

e. Examine the deceased for any disease, surgical intervention, etc. which could have contributed to the death of the deceased.

f. Locate and describe any defence injuries.

g. Record all the injuries on the body of the deceased in detail and the information about the type of firearm used.

h. Record all the negative evidence.

3. Handling Firearm Injuries

The medico-legal expert should:

(a) Observe, photograph, sketch, illustrate and record all the injuries, major or minor, internal or external.

(b) Observe and evaluate a firearm injury carefully. Describe fully the wound of entrance, the internal track and the lodging site of the projectile(s) or the exit wound. Give serial numbers to each injury. The description should contain (whenever possible):

a. The possible nature of the firearm.

b. The presence or absence of GSR.

c. The direction of fire and deflection, if any.

d. The condition of the projectile: Whole/deformed/fragmented.

e. The presence/absence of any extraneous matter on the projectile (from the intermediate target or from the ricocheting surface).

f. Log all information collected through: Photographs, X-ray radiograph, sketches, text.

In an interesting case, the doctor carrying out the post-mortem described a sharp-edged weapon injury. The informant had seen it as a gunshot wound and objected to the finding. A board of 5 doctors was constituted which could not give definite opinion on the nature of the weapon causing the injury. Ultimately, the case went to the Forensic Medicine Department. An X-ray revealed a bullet lodged in the pelvis bone confirming the contention of the informant. (CH)[1]

1. *Nirmal Singh* v. *State of Bihar,* 2005 Cr LJ 672 (SC).

(c) All the evidence should be located, collected, preserved and logged in the same way. The evidence include:
   a. The wads, if any.
   b. The extraneous deposits.
   c. A charred skin piece in burning cases.
   d. GSR found on hand of the deceased.

(d) Requisition the help of the ballistic expert, if required.

4. Internal Examination

Internal examination involves checking of all the major body organs, cavities, bones, for injuries, extent of damage, decapacitation, defects, etc. The examination should be systematic and properly documented. Usually the departments have forms prescribed for recording the observations. They should be used.

The following body parts are observed invariably with extra care:—

a. Head.
b. Neck.
c. Respiratory system.
d. Cardiovascular system.
e. Gastrointestinal system.
f. Reproductive system.
g. Urinary tract.
h. Muscle-skeletal system.
i. Pancreas, spleen, adrenals, biliary tract.

These organs should be examined not only for firearm injuries but also for any abnormality or disease. If nothing abnormal is noticed, its absence is recorded. Usually the letter NAD (Noting Abnormal Detected) is used for the purpose.

5. Toxicological Material

In cases of deaths by shooting, the toxicological examination is not necessary. However, in certain cases where the shooting is suspect, toxicological materials should be collected. However, as a matter of abundant caution, blood, urine, vitreous and bile fluids should be preserved for about a year.

6. Opinion

The opinion of the medico-legal expert is the brief conclusion of the observations and inferences. The main information in the opinion is:—

a. Cause of death.
b. Mode of death.
c. Time of death.

The medico-legal expert supplies additional information on demand.

7. Post-mortem Report

The characteristic deposits and damage for the identification of the firearm injuries are available only to the medical officer carrying out the medico-legal

examination. Others, who are vitally interested in the evaluations of the firearm injuries, are the court, the counsels and the firearm expert. They depend upon the documentation/description in the post-mortem reports or their statement in the courts. They should be concise, precise, illustrative and intelligible.

The method of recording the firearm injury evidence must undergo substantial improvements if they are to be used to identify the firearm and to interpret the sequence of events to verify a given hypothesis from the post-mortem reports.

Consider the following cases:—

The injuries on a victim were a rat hole surrounded by small orifices. The alleged distance of fire for the only shot fired, according to the eyewitnesses, was about 8 metres.

The defence produces an expert and quoted authorities to indicate that separate holes for separate pellets are formed when a shot is fired from a distance of 4 metres or more. The defence argued that the small orifices might have been caused by the shot fired by the accused as it was fired from 8 metres. However, some other person, from a closer range, must have fired the fatal shot, which caused the rat hole. The accused was, therefore, not the murderer according to the evidence produced by the prosecution.

Was the contention of the defence correct? (CH)

A dead body was discovered in a jungle. A shotgun and a bandolier were lying close by. The person had one entrance wound in the right iliac region. The injury had gone steeply upward and inward. The charge of a 12-bore cartridge was found lodged near the left armpit inside the skin.

1. *Only one injury – wound of entrance.*
2. *The whole charge of a 12-bore cartridge was found at the above-mentioned site, almost under the skin.*
3. *The angle of fire was almost 75°.*

The relatives alleged murder. The case was referred to the author. Was it murder? The position of the entrance wound and the deposit site of the whole charge gave a direction, which no murderer would adopt. Further, examination of the gun revealed that it was defective. It would go off if its butt hit something with (like hard earth) some force.

It could not be a murder. It was probably an accident.

Why? (CH)

In view of the increasing importance of the firearm injuries in the reconstruction of the sequence of events and in the verification of the differing versions, it is essential that the data collected and given in the post-mortem reports is correct and complete. It is possible if:—

1. A firearm expert is present at the time of the post-mortem or the medico-legal examination in cases involving the firearm injuries.
2. Only the specified experienced medico-legal experts should handle the medico-legal work. At present most of the examinations are being

carried out by the medical officer who happens to be the nearest to the police station. Often the doctor is not qualified for the work.

3. The medico-legal experts who carry out the post-mortem and the medico-legal examination ensure that:—
   a. The clothes of the victim are collected invariably. They should be dried, packed, stored and transported in such a way that the evidence thereon is not destroyed in the processes. They should be sent to the firearm expert in all cases.
   b. The victims in the shooting cases must be X-rayed in all cases to locate the projectiles before their extraction.
   c. All the firearm injuries should be photographed along with a scale before and after cleaning the wounds. The washing should be preserved and sent to a forensic science laboratory.
   d. The contusion, dirt-ring, blackening, tattooing and scorching are correctly discriminated by chemical tests and microscopic examination. The findings must be recorded in writing at the time of the medico-legal examination.
   e. The dimensions of each injury and inter-distances between various injuries are recorded properly. The evidence that the given wound is an entrance wound should be studied and described carefully.
   f. The projectile track inside the body is described from the entry point to the exit point. It should be carefully described in all fatal cases. The damage should be carefully assessed. Any broken bones in the track should be X-rayed and described.
   g. The entrance/exit wounds and internal damage are described/ illustrated/diagramed on graph paper to show the height, angle, direction, the deflections (if any), dimensions, broken bones and the tracks of secondary projectiles (if any). More than one chart may be prepared and used, if necessary.
   h. The whole projectile charge, including wads, if any, should be recovered without causing additional damage. The positions of the various items recovered should be indicated on the diagrams and described fully. The medical officer should, use the non-professional's language, as far as possible, to describe the involved body parts and the processes.
   i. The outline diagrams of the body in which the injuries are shown need change. The background in the outline is kept blank at present. It should be graph paper, printed in very light blue, pink or green ink. If the doctors indicate the height of the person, the graph will help to find out:—
      (1) The height of the injury.
      (2) The exact location of the injury.
      (3) The inter-distances between the injuries.
      (4) The direction and size of the internal track.
      (5) The dimensions of the injuries.

(6) The area covered by the injuries – important to determine the range of fire in shotgun firing.

(7) The deflection of the projectile, if any.

The importance of sketches on graph paper cannot be over-emphasised. It can improve the understanding of the medico-legal reports tremendously. There are some indirect advantages also. Firstly, the officers carrying out the medico-legal examination will be more careful in detailing the nature and location of the injuries. Secondly, the terminology, which is so troublesome at present, will not be so bothersome in the reconstruction of the events, as it will facilitate fixing the location of the injury.

8. MISCELLANEOUS

8.1 Post/Ante-mortem Injuries

In shooting cases, it is often necessary to establish that the given firearm injury is ante or post-mortem, to establish whether the defence or prosecution version is correct.

The ante-mortem injuries bleed profusely while post-mortem injuries bleed less unless some blood vessel is punctured. If the injuries are made on a dead body, which is still warm, it bleeds more than when the body is cold. The behaviour of the skin and tissues punctured is also different.

Only an experienced doctor can determine the facts.

8.2 Fatal Injuries

A firearm injury is often fatal due to haemorrhage, shock and complications of the injuries. However, if a vital part like brain, heart, lung, spinal cord or aorta is not affected and the injuries are attended to immediately, the person may survive when there is no excessive blood loss.

A victim sometimes performs certain extraordinary acts before he collapses. The defence in such cases argues that the victim must have died of some cause other than the firearm injury, because the gunshot should have stopped the victim immediately. This argument is not justified. The human body (and mind) sometimes behaves in an extraordinary way. They can perform acts, which are considered improbable on medical considerations.

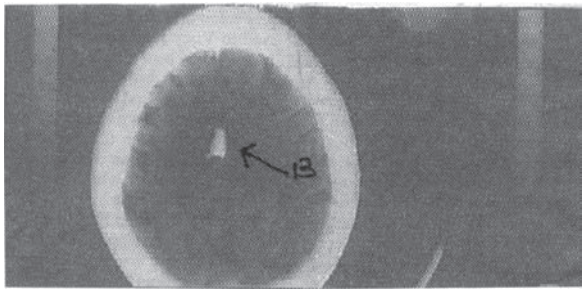


Fig. XVII-5

Alive and kicking, even with a bullet (B) in the brain for the last seventeen years. Impossible medically?

8.3 Age of Injuries

It is sometimes required to find out the age of the injuries. It is ascertained from:—

1. The quantity of the bloodshed when the injury is still bleeding.
2. The inflammation (or putrefaction) of the injury, if it is an old injury.
3. The extent of the healing, the treatment given has important bearing on the extent of the healing.

Only an experienced doctor can estimate the age of the injuries with some accuracy.

SHOTGUN INJURIES

SYNOPSIS

1. **GENERAL**
2. **SHOTGUN CARTRIDGE**
3. **SHOTGUN**
   - 3.1 The bore
   - 3.2 Barrel lengths
   - 3.3 Chokes
   - 3.4 Rifling in shotguns
4. **FIRING PROCESS**
5. **RANGE OF FIRE**
6. **ANGLE OF FIRE**
7. **RICOCHET**
8. **INTERMEDIATE TARGET**
9. **VELOCITIES**
   - 9.1 Entry wound
   - 9.2 Exit Wounds
   - 9.3 Internal Injuries
10. **TARGET**
    - 10.1 Head Injuries
      1. Contact/Near Contact Shots
      2. Powder Range Shot
      3. Distant Shots
    - 10.2 Torso Injuries
    - 10.3 Limb Injuries

18

SHOTGUN INJURIES

(1) Indicates the entrance hole.

(2) A radiograph showing location of the projectiles.

(3) Another radiograph showing the complete shattering of the skull and other nearby bones.

Figs. XVIII-1, XVIII-2, XVIII-3

The above series of photographs indicate the havoc brought by a 12 bore contact shot.

1. GENERAL

Shotgun wound ballistics discussed here relates to the standard 12-bore shotgun, unless otherwise mentioned specifically. In the cartridges of other standard bores, the charges are either more (in 8 or 10 bore cartridges) or less (in 16 or 20 bore or .410 calibre cartridges). The ballistics of these firearms stand modified quantitatively accordingly as far as the wounding effects of these shotgun cartridges are concerned. However, the general characteristics of the wound ballistics of all shotguns correspond to those of 12-bore shotgun and corresponding ammunition, in a general way.

Shotgun ballistics involves the following parameters:—

1. Shotgun cartridge:

a. The projectile charge.
b. The wads.
c. The propellant, its nature, condition.
d. The prime composition.
e. The cartridge case.
f. The packing.

2. Shotgun:

The main features of the shotgun, which affect the ballistics, are:

a. The barrel length.
b. The bore.
c. The choke characteristics.
d. The rifling, if any.
e. The firing mechanism.

3. Firing Process:

a. The range of fire.
b. The velocities developed.
c. The intermediate target, if any.
d. The firing angle.

4. Target:

a. Hardness of the target.
b. Shape of the target may deflect the projectile.
c. Passage length.

2. SHOTGUN CARTRIDGE

In shotgun wound ballistics, the following factors relating to the shotgun ammunition are relevant.

1. The projectile charge in shotgun cartridge usually consists of spherical projectiles, called pellets, buckshots or balls. Sometimes slugs or flechettes, which are not spherical, also form the projectile charge in some countries, not common in India. The spherical projectiles are

ballistically inefficient. They lose aim and range rapidly. The loss of velocity decreases the range more quickly in lighter projectiles as compared to heavier projectiles. As mainly the velocity controls the wounding effect of a projectile, the projectiles lose wounding power soon after leaving the muzzle. Ball and slug projectiles continue to be dangerous even at long ranges.

2. The aiming range in shotgun fire, due to spherical shape of the projectiles, is limited. The air resistance of the projectiles here increases with range, which in addition to reduction in velocity diverts the direction of the projectile affecting the aim substantially. The spread of projectiles, which cover increasing areas with range, however, compensate for the poor aim.
3. Single projectile ammunition is used to hunt big games in some countries. The projectiles have special fin like structures. The fins give spin to the projectile(s); or, the shotgun barrel is rifled to give spin to the single projectiles, which improves both the aim and the range of the projectile.
4. **F**lechettes projectiles Ammunition for the shotguns (12-bore) is comparatively a recent development. These are arrow like projectiles, made of steel, with fins at the base. 20 flechettes, each weighing about half gram, form the standard projectile charge of a 12 bore cartridge. The flechettes are fixed on to a sabot which takes them safely through the barrel and which gets separated soon after coming out of the barrel. The following advantages are claimed for the cartridges by the manufacturer:—
   a. Less weight.
   b. Perform better– give better patterns.
   c. Do not damage the weapon (sabot effect!).

   Ammunition with flechette projectiles is not manufactured in India so far. Nor has it been involved in shooting case in India so far, as far as the author knows.
5. The projectile charge, after its ejection from the muzzle, goes on spreading, covering larger and larger areas with the increasing ranges. The number of the projectiles hitting a given target, per unit area, becomes less and less. Hence, the wounding effect of the charge is reduced due to the lesser number of projectiles hitting the target, with increasing range. The wounding power also decreases due to rapidly diminishing velocity of the projectiles.
6. The wads have the same velocities as the projectiles at the muzzle, but because of the size, shape, sectional density and weight they lose velocity soon after expulsion from the barrel. At close ranges, the wads enter the body along with the projectile charge. At intermediate ranges, they may create separate injuries or leave their marks on the body. At longer ranges, they fall en route.

7. The wounding effect of wads is seldom important as their contribution is overshadowed by the devastating effect of the projectiles. They, however, become important in the following situations:—
   a. If blank cartridges are fired from contact or close range, the wads enter the body along with the ejecta and may cause fatal injuries.
   b. The presence of wads in the body indicates close range firing.
   c. The presence of wad marks on the target indicates short-range shot.
   d. The size of the wad indicates the bore of the firearm.
8. The blast effect at the muzzle is devastating. The gases come out at a pressure of about 45 to 200 atmospheres. It is sufficient to kill a person, but the blast pressure is reduced within a short range: within centimeters and the blast becomes ineffective. If the ejecta enter the body, as in contact or near contact shots, they shatter the target, if they do not get sufficient space to expand inside the body.
9. The protective sleeve for the projectile charge in power-piston-pouch cartridges, being used in shotgun cartridges, prevents the deformation of the projectiles, increases the range and improves the aim. In addition, it increases the density of the projectiles hitting the target, evidently by reducing the friction of the projectiles with the sides of the barrel, which reduces the loss of energy and eliminates the deformation of the projectile charge. The ballistics is thus improved.
10. The plastic cup wad over the powder charge, by sealing the barrel bore, also improves the ballistics of the projectiles by preventing the wasteful escape of gases from the sides.
11. The powder charge has profound effect on wound ballistics. The main variables in the powder charge are:—
    a. The quantity of the propellant charge effect is obvious. More the propellant, more the gases produced, which develop greater pressure, which in turn, impart higher velocities/higher kinetic energy/higher wounding power to the projectiles.
    b. The rate of burning of the propellant affects the ballistics. It should be such that the whole powder charge is consumed before the projectile charge reaches/exits the muzzle. The size, shape, surface area exposed to burning, the packing and temperature/pressure generated in the firing process control the rate of burning of the powder charge. These factors are carefully controlled in the ammunition manufacture, to achieve the optimum results.
    c. The quality of the powder is important. The 'Hang Fire' (delayed and slow burning) in some cases is due to defective powders. It can also be due to the defective percussion cap or improper packing.
12. The crimp closure of the cartridge has the potential of opening up of the cartridge and spilling out of the projectiles through rattling.

It is prevented by filling in the inter-spaces with granular polythene material. The material forms part of the ejecta and gets deposited at the target as part of the GSR, up to 6-8 metres.

3. SHOTGUN

The shotguns vary in construction design; bore size, barrel length, firing mechanism etc. However, the main factors, which affect the wound ballistics, are:—

1. Size of the bore.
2. Length of the barrel.
3. Choke characteristics of the muzzle.

3.1 The bore

Shotguns of wider bore[1] (10, 8), use bigger cartridges. They contain heavier is the charge/load in their cartridges, usually. Naturally, heavier the charge, greater is the wounding power of the cartridge-firearm combination, to inflict more lethal wounds. The commonest bore in India is 12 bore. 16-bore shotguns are also seen but only rarely. The shotguns of other bores are almost non-existent in India.

A smooth bore firearm of calibre .410, known as *musket*, is a conversion from .303 rifles. It is still in use in India. It is used to fire single ball and pellet charges. Musket is a prohibited-bore firearm.

The author has not come across other bores (8, 10, 20, 28, etc.) in criminal cases. Nor has he come across smooth bore handguns, which are used to kill pests like rats, snakes, etc. They are perhaps not used in India; otherwise, they would have surfaced in some shooting cases. Nevertheless, their forensic ballistics should correspond to other smooth bore firearms.

3.2 Barrel lengths

The common barrel lengths of 12-bore shotguns are now 65 or 70 centimetres[2]. The optimum length of a shotgun barrel should be about 40-cm. Longer barrels offer some advantage to the shotgun ballistics. It has been found experimentally that:

a. If the barrel length is 30 cm e or more, the given propellant is consumed and it gives the intended muzzle velocities.
b. If the length is less, the muzzle velocities start falling rapidly (incomplete combustion of the propellant!).
c. Longer barrels provide wider sight circle to ensure better aim. Wider the sight circle better is the aim. Thus, they obviate the need of optical sights for better aim.
d. It makes the gun heavier. Heavier the gun is, lesser is the recoil. The devices like muzzle break, to control the recoil become unnecessary. However, a lighter gun gives less fatigue to the shooter.

1. The bore in shotgun is given in numbers. For example, a 12-bore shotgun has a diameter equal to the diameter of a lead ball weighing one-twelfth (1/12) of a pound, roughly 38 gm.
2. The pump-action shotgun of the Indian Ordnance Factory, is 51 cm long.

e. The shotguns with longer barrels give lesser vibrations. Hence, they are steadier.

Criminals often shorten (saw off) the barrels. It reduces the wounding power and increases the recoil.

The sawed off guns provides better linking evidence in two ways:—

a. The cut edge can mark the projectile and/or the plastic wad(s) characteristically which may help to link the fired ammunition with the firearm.

b. The metal particles from the cut muzzle edge, carried by the muzzle blast, are deposited at the site. They may permit their linkage with the gun/culprit through trace elemental analysis and comparison.

3.3 Chokes

A choke has profound effect on wounding. It increases the number of the projectiles hitting the target and consequently, the number of injuries and incapacitation is increased.

A choke does not affect wounding power at close (powder) ranges to any appreciable extent. Here the entire (or most of it) ejecta enters into the target as if it were a single projectile, up to about three metres. The wounding effect is similar up to this range though the wound size becomes larger and the edges of wound become somewhat serrated. With increasing range, beyond three metres, the killing/wounding power starts declining. Some pellets/buckshots start creating separate holes.

For all practical purposes, the wounding power of the shotgun shots continue to be equally effective with all chokes (or no choke) up to a range of 10 metres (spread 25 to 50 cm). The pellet charge mostly creates one rat-hole surrounded by individual pellet injuries. In the case of buckshots, often no rat-hole formation take place, yet due to the limited spread, they prove fatal, even with the shotguns having different chokes or no chokes. The inter-distances between the individual entry holes may vary somewhat with different chokes.

The chokes influence spreads significantly when the firing ranges are beyond 10 metres. The number of projectiles hitting the target varies with the choke characteristics. The number of the projectiles hitting the target, changes with the changing characteristics of the choke. The table 1 below gives average number of pellets hitting the target (in 75 cm diameter circle), at 30 metres.

TABLE XVIII-1

Range =30 m

Choke Characteristics	*% of pellets hitting in a 75 cm. circle*
1. Full choke (1 mm)	70
2. Half choke (.5 mm)	60
3. Quarter choke (.25 mm)	45
4. Improved cylinder (.1 mm)	40
5. Cylinder (0 mm)	30

As there are a number of variables controlling the shotgun ballistics, the percentages given above are approximate for standard shotguns only. They are applicable to shotguns of various bore sizes (8, 10, 12, 16, 20, 28, etc.). They are not applicable to improvised firearms.

There are other types of chokes also. However, they are not met with in crime situations in India. Elsewhere also, they have little practical applications.

3.4 Rifling in shotguns

The rifling in shotguns is utilized for ball or slug ammunition to increase the range and to improve the aim. They achieve better wounding effect at all effective ranges.

The rifling is done either to the slug itself or to the barrel. In both the cases, the projectile emerges from the muzzle with a spin around its longitudinal axis. The spin reduces the loss of velocity and hence of the striking energy, thus increasing the effective lethality. Besides, as the air in front of the projectile is dispersed by the spin an air wall of increasing resistance is not created. The projectile is not deflected, which improves the aim.

4. FIRING PROCESS

Fig. XVIII-4

Both barrels of a DBBL gun fired almost simultaneously. Created two entry wounds, not one

The firing process involves:

a. Initiation,
b. Combustion of propellant,
c. Trajectory, and
d. Impact of the projectile at the target.

The influence of the first two factors is easily understood; but some persons, perhaps, do not know the effect of angle of contact. The angle of contact affects the extent of the yaw the projectile suffers inside the body. The yaw determines the transfer of kinetic energy from the projectile to the body tissues with which the projectile comes in contact. In shotgun shots, the projectiles are spherical, in which there is no yaw. The problem of yaw in the shotgun shots comes up only in slugs. Here also the problem is academic only. Slugs do not perforate the body most of the time and thus, they transfer entire energy to damage the body tissues.

5. RANGE OF FIRE

The range of fire plays a decisive role in the wounding power of shotgun shots. This is mainly due to the following reasons:—

1. Ordinarily, the shotgun ammunition contains pellets and buckshots. They are spherical projectiles. They lose velocity rapidly. So much so, that the pellet charge is ineffective beyond 40 metres; buckshots are ineffective after 100 metres, though they may travel a long distance beyond. They may remain dangerous for some more distance also. Balls and slugs, especially if they have acquired spin, can be effective at longer ranges. They are not used often, in India. The decrease in velocity and hence in striking energy, is rapid in most of the cases.
2. The projectile charge spreads increasingly with the increasing range. The number of projectiles hitting the target of a particular dimension goes on decreasing with the increasing range. Consequently, the wounding power of the shotgun shot decreases as the range increases. As the wounding power depends upon the energy transfer, it is simple mathematics that lesser the number of projectiles hitting the target the lesser will be the energy transfer to the target, and hence lesser the wounding power.
3. At contact or near contact ranges, the shotgun shot causes most devastating injuries. At such range the whole ejecta enters the body *en masse.* The gases expand there and cause 'explosive' wounds, i.e., as if an explosion has taken place inside. It blows off the body parts, if there is no adequate space for expansion of gases. Explosive phenomenon is mainly observed in close range/contact head injuries.

CONTACT/CLOSE RANGE SHOTGUN PHENOMENA

1. **Explosion-like shattering of the head (target).**
2. **Single circular/elliptical entry hole (dia. 2 to 4 cm); no additional pellet holes.**
3. **Charring/burning of the skin/tissues around/in the hole**
4. **Singing of hair.**
5. **GSR deposits around the entry hole/on brain tissues.**
6. **Tattooing.**
7. **Pink colouration around the hole; Carbon monoxide absorption.**
8. **Dirt ring/abrasion ring/contusion ring, around the hole.**
9. **Wads inside the wound.**
10. **Suicidal sites: palate, under chin, chest.**

4. The blast effect of the gases and other ejecta is lost when the range of fire is more than a few centimetres. In fact, the devastating effect of shotgun shot is only from the contact or near contact range, when the blast material including gases enter the body *en masse.*
5. Shotgun shots continue to cause lethal wounds at intermediate ranges also, up to which most of the charge hits the body.
6. It is only at long ranges that the shotgun shots become ineffective. This is especially so when the cartridge is loaded with pellets.

6. ANGLE OF FIRE

The angle of fire practically does not change the wounding effect of the shotgun shot if the shot is fired from close or intermediate ranges, as in such cases the whole or most of the charge enters the body. However, if the angle is very low, the projectiles give a glancing impact, they may escape without causing serious wounds.

The angle of fire in distant shotgun shots affects the wounding power of the shot by spreading the charge. There are two opposite results:—

1. If the spread is such that part of the charge escapes from coming in contact with the target/body; the part of the charge is wasted and hence lesser amount of energy is transferred, reducing wounding effect.
2. If the angular fire increases the hit area, the wounding power of the shot increases, as more pellets hit the target. More kinetic energy is transferred, causing more serious wounding.

In an interesting case, a shotgun, with an LG load cartridge, was fired from a distance of three metres at an angle of 20^0. Part of the charge hit the left shoulder. One LG shot hit the neck and exited after travelling under the skin along and below the left jawbone. The major part of the charge hit the head just above the ear. The third injury was in fact the major and fatal injury. If the shot had not been angular, it would have perhaps hit only the shoulder or some other body part, causing a non-fatal injury. (CH)

In another case, the culprit fired a shotgun shot on a Maruti car, which was climbing a hill, covered with forests in HP. It was essential to establish the position of the shooter to locate evidence. A visit to the scene of crime, and the estimation of the angle of fire gave the position of the shooter within reasonable limits. (CH)

The angular fire creates oval shape entrance wound. Firing at right angles to the target causes round holes.

Angular fire affects scorching, blackening and tattooing patterns. A right-angle fire creates a circular GSR/pellets mark pattern. Angular fire creates oval shape pellets/GSR patterns.

7. RICOCHET

The ricochet has not been studied in detail in shotguns shots. However, if the striking angle at the target is less than the critical angle the projectiles may ricochet. The comparatively soft nature of the material (lead), may however, resist ricochet unless the striking angle is low enough and the target surface is suitably hard. Boney and curved surfaces facilitate ricochet and cause grazing injuries. The pellets, made of hard materials, like steel, have greater chances for ricochet.

Ricocheted bullet often has sufficient kinetic energy to cause serious/fatal wounds.

8. INTERMEDIATE TARGET

The usual intermediate targets, involved in some shooting cases, are:—

1. The glass and the metal screen windows.
2. The car wind screens.
3. The wooden or metallic doors.
4. The aluminum panels.
5. The clothes.

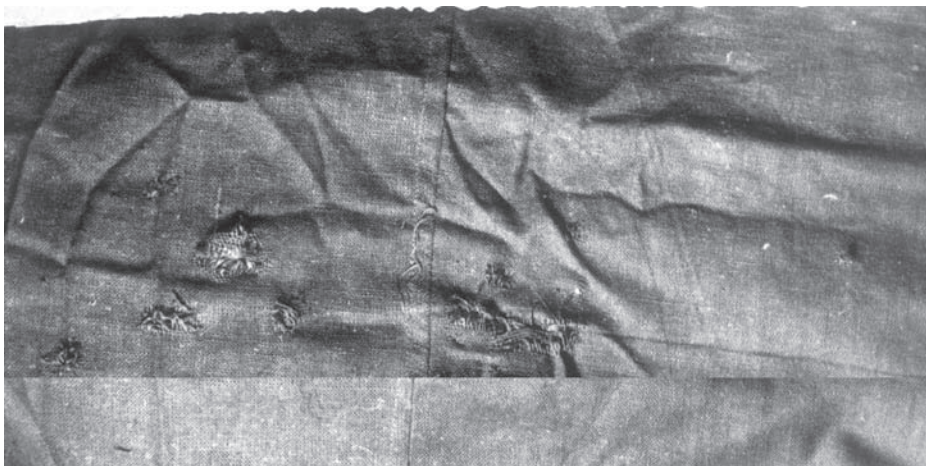


Fig. XVIII-5

Projectile holes on clothes should correspond to injuries on the body of the victim.

The intermediate targets have considerable influence on the wounding power of the projectiles, especially in the case of shotguns.

The effect of the intermediate target depends upon the material of the intermediate target:—

1. Its tensile strength.
2. Its thickness.
3. Its elasticity.

The intermediate target usually increases the spread of the projectiles. It is essential to take the influence of the intermediate target into consideration to find the range of fire from the observed spread on the body of the person, whenever the projectiles have passed through an intermediate target

Experiments have shown that the intermediate target influences the spread only if the target is thicker than the critical thickness. The critical thicknesses of some common materials are given in table 2, below.

TABLE XVIII-2

Material	*Thickness*
1. Cardboard	3.0 mm
2. Safety glass in vehicles	0.3 mm
3. Plywood (ordinary)	1.0 mm

The intermediate targets affect the velocity of shotgun projectiles. The extent of the effect varies with the nature of the intermediate target and the striking energy of the projectile. A thick target can reduce the velocity so much that they may not cause fatal/serious injuries. Besides, they can deflect the projectiles from its original path.

The wearing apparel has practically little effect on the ballistics of projectiles, if the shotgun shot is fired from close or intermediate ranges.

Body parts, skin, flesh, bones have extensive influence on the dispersal of the projectiles in shotgun shots. The dispersal found inside the body cannot be used to determine range.

If the nature of the intermediate targets is known, workable estimates of the range can be obtained by test firing through a similar intermediate target.

In short, the influence of the intermediate targets is on the usual lines:—

1. If the intermediate target is thin and soft, it may not influence the ballistics or the wounding power of the projectile significantly.
2. If may increase the spread area.
3. The slow moving pellets also affect the spread due to **'billiard effect'**. The faster moving projectiles may hit frontal slow projectiles, change their original direction and, in turn, they slow down. The 'billiard effect' increases the velocity of the hit pellet along with changing its direction.
4. They may cause backscatter of the projectile.

5. They may change the direction of the line of fire.
6. They may fragment to form secondary missiles, hit the intended target and cause separate injuries.
7. The projectile may fragment or get deformed. Fragments may cause multiple injuries. The deformation may change the shape of the injury. The transfer of kinetic energy due to deformation may be more, hence greater damage.
8. The velocity of the projectile and hence the striking energy and the wounding power of the projectile are reduced. The quantum of reduction depends upon the intermediate target, the angle of strike, etc.
9. If the striking angle is low, the projectile may get deflected (ricochet) and may or may not scrape or injure the body.
10. If the projectile is of soft material, it may pick up the pattern from the intermediate target surface and carry it along into the target. The pattern is a great help in the reconstruction of the occurrence.

Fig. XVIII-6

The impression of the wire screen on the projectile (LG shot) recovered from the body of deceased indicates the existence of an intermediate target.

9. VELOCITIES

The velocities, of the projectiles, fired from shotguns, determine their wounding powers. They create the usual trinity of the injuries; the entry wound, the exit wound and the internal wound. The following points about the effects of velocities of shotgun projectiles are noteworthy:

9.1 Entry wound

(1) The muzzle velocity of shotgun projectiles is about 400 m/s.

(2) The projectiles must possess threshold velocity (the minimum velocity to penetrate the skin). If the loss of velocity of the projectile, during its flight, is such that the striking velocity is less than the threshold velocity, it may cause only a contusion at the site.

   a. Threshold velocity for piercing skin = 40 m/s.

   b. The threshold velocity for penetrating bone = ~ 60 m/s.

(3) The projectiles cause entry wound of the same diameter, or slightly lesser than the striking projectiles.

(4) The projectiles lose their velocity with the increasing range quickly, being of ballistically inefficient shape. Consequently, shotgun projectiles are effective at short ranges only:

   a. Pellet charge is lethal up to 40 m.

   b. Buckshot charge may cause serious injuries up to 100 m.

(5) The projectile charge enters *en masse a*t close ranges, along with the other ejecta to cause explosive wounds. They devastate the body tissues hit, especially if the charge hits the head. The shot explodes the head. One has to reconstruct the entry wound from the shattered skull bones, some times.

(6) Shotgun projectiles do not create temporary cavities, consequent extravasation, and extensive damage.

9.2 Exit Wounds

The following points are noteworthy about exit wounds:—

(1) Pellets often do not form exit wounds. They exit only when the shot is fired from contact or close range and the shot accompanies the blast, which blows off the hit body part (head!). In such cases, most of the small pellets exit.

(2) Buckshots of LG, SG, SSG sizes, fired from close or intermediate range, sometimes create exit wounds if bones or other obstructions do not stopped them. In long-range fire, they do not exit.

(3) The ball ammunition and slugs may form exit wounds if the striking velocity is not too low and there is no substantial bony obstruction.

(4) The buckshots and ball or slug projectiles are often deformed, flattened or fragmented if they meet hard boney obstruction. The deformations, etc. cause serious injuries and may prevent exit.

(5) The size and shape of the exit wound is determined by the shape, size and weight of the exiting fragment/projectile. The body tissues, if they are being pushed in front. They change the dimensions of the exit wound.

(6) On parity with entry wound, the exiting projectile must have more than threshold velocity to exit (Skin = ~ 40-50 m/s; Bones = ~ 60 m/s).

9.3 Internal Injuries

The following points about the internal wounding of the body by shotgun shot are noteworthy.

(1) The internal injuries of a shotgun shot, up to powder range, are devastating as if some explosion has taken place, as the charge enters the body *en masse*. Most of the ejecta, especially the projectiles, are found inside the body.

(1) The body retains the projectiles, most of the times, as the whole kinetic energy is expended in causing the injuries. The projectiles are found embedded at the end of the wound-track.

(2) Ball, slugs and buckshot may form exit wounds sometimes.

(3) The projectiles may enter en masse but after entering, they spread inside the body. This spread cannot be used for ascertaining the range of fire. The spread, however, inflict multi-channel injuries inside the body.

(4) The projectiles are deformed if they strike some bone, otherwise their shape remain what it was at the muzzle.

(5) A shotgun blast can cause fatal injuries, even when there is no projectile charge, if the fired shot is from contact/near contact range.

(6) The damage of the tissues of the internal wound depends upon the firearm, ammunition, shot size, deformation of the projectile and range of fire.

(7) The wad/wads are found in the wound if the shot had been fired within the powder/tattoo range.

(8) The ball/slugs/ buckshots, recovered from the body (or from the scene) may permit their linkage with the firearm, which fired them.

10. TARGET

The main features of the human body as target, influencing the wound ballistics are:—

a. The nature of the surface hit, at the target, flat or round.

b. The hardness of the surface.

c. The elasticity of the skin, flesh tissues, bones, at the site.

d. The internal structure of the body tissues at the site.

Based on the above, the major important anatomical body parts *vis-à-vis* firearm injuries are:—

1. Head.
2. Torso.
3. Limbs.

1. Entry wound

1. Exit wound

Figs. XVIII-7

Through and through shotgun injuries from close range. Surprise: no blowing off the head. Perhaps temple effect?

10.1 Head Injuries

The human brain is the most sensitive part of the body. It is protected by a strong boney structure – the skull. If a projectile strikes the head and compresses the structure with sufficient pressure but does not penetrate the bone, the subject may suffer from concussion. Usually, he does not die though he may continue to suffer from headaches for months. It is rare that concussion may cause brain hemorrhage and prove fatal. Once, however, the skull is pierced, the projectile reaches the brain matter. Brain injuries are usually fatal. It is extremely rare that the projectile after penetrating the skull does not damage the brain matter. Consequently, almost all head firearm injuries prove fatal.

> *In an interesting case, the bullet hit the forehead of the victim at an angle. It entered the head just above the right eye. It came out near the left ear. The subject, except for the shock, suffered no major damage to the head. Medical examination revealed that the projectile had travelled all the way around the skull under the skin. Angular hit and tensile strength of the skin muscles were perhaps responsible for the unbelievable occurrence. (CH)*

The head injuries do not prove fatal if the projectile does not injure the brain matter. The skull bone is not only thick and strong but it is also round. Often angular shots ricochet from the head causing abrasion or cutting injuries only.

The projectile, in order to penetrate the skull bones must possess:—

1. Adequate striking velocity.
2. Proper angle, right or close to right angle.
3. Adequate projectile stability so that it does not fragment on hitting, before entering into the head.

The head bone structure is not uniformly thick and strong. There are weak points, which are comparatively susceptible to easier penetration. The soft sites are:—

1. Cranial cavities: mouth, eyes, ears.
2. Temple.

It is due to these soft sites that the suicide uses them to commit suicides. For example, an American study revealed they have used as target site:—

1. Mouth = >60% cases.
2. Temple =15% cases.
3. Forehead has been used by those who were not familiar with the skull anatomy.

The range of fire, in shotgun shot to cause head injury, has profound effect on the extent of tissue damage.

1. Contact/Near Contact Shots

Fig. XVIII-8

Close range entry wound from a sawed-off 12 bore gun. Remaining barrel length 12 inches.

The shotgun contact/near contact shots at the head are devastating. They literally blow off the head. The shattering is due to the fact that the total ejecta (gases, GSR, wads, projectiles) of a shotgun shot enters the head *en masse*, transferring most of its energy to the head. The gases expand and usually break or crack the skull bones, at a number of places. The projectiles impart their kinetic energy to the skull (or its fragments) and turn them into missiles, which fly away from the structure in different directions. The following are the major characteristics of the contact head injuries:—

1. The GSR, along with the other ejecta, enters into the wound. Considerable quantity of GSR may be found deposited inside, provided the portion on which the GSR is deposited, is not blown off.

   In an interesting case, the accused was seen killing a person with the help of a sawn off 12 bore gun, by a number of witnesses. The gun was pressed against the head of the victim. Post-mortem examination revealed complete absence of GSR inside or outside the head. Part of the head had blown off. It appears that the part with deposited GSR had been blown off and did not form part of the body was missing at time of the post-mortem. There was no other explanation for the absence of GSR inside or around the wound. (CH)

2. If the skin is not torn, usually there is GSR around the wound. GSR enters the head and causes blackening inside. The edges are usually blackened.
3. The brain matter is shredded, compressed and mashed. When the skull opens, the brain matter may be thrown out all around at the scene site.
4. The size of the entrance wound corresponds to the size of the bore of the weapon. In a 12-bore shotgun, the diameter is roughly 2 cm.

5. The wound is usually round or slightly oval depending upon the angle of fire.
6. The edges of the wound are contused.
7. Considerable quantities of GSR are deposited in the wound. It may or may not be present outside, or, on the edges.
8. Wads are found in the wound.
9. GSR may not be visible in some cases. Here the tissues on which the soot gets deposited are blown off, taking along with them the deposited soot.
10. In rare cases, the gases enter between the bone and the outer skin and create star-shaped tears (rents).
11. Intra-oral shotgun injuries, the following features:—
    a. Ordinarily, they are easily located due bleeding, deformation of the face, etc. There is GSR on the palate, tongue and sometimes on the lips also.
    b. The injury distorts the facial features in most of cases even if it is not shattered. Gases puff out the facial parts unevenly and, thus, distort features. This is especially so in nasal structures.
12. Some wounds may not be visible (only very rarely) for example Intra oral wounds.
13. In contact or close contact firing, skin, flesh, blood, etc. may blow backward, which may get deposited inside and outside the muzzle of the weapon used. Modern DNA profiling techniques can provide definite linkage between the weapon (and hence the culprit) and the victim.
14. A shotgun contact wound often appears as if an explosive has been exploded in the head or mouth to cause the injury.
15. There are muzzle marks around the hole in contact wounds.
16. Burning, blackening and tattooing usually surround the hole in close contact wounds. In some cases the phenomena is not observed around the wounds.

    In an interesting case, the entire left side of the face of a girl was blown off when a gun went off accidentally. The doctor who was carrying out the post-mortem would not believe that it could be a firearm injury until on the insistence of the author he took an X-ray of the head. He could recover almost half the pellet charge from the back of the head. (CH)

2. Powder Range Shot

Powder Range Shot from a shotgun are devastating, though some of the phenomena observed in contact wound such as the scorching and deposits of the GSR inside the track are often absent. The explosion-like injuries are ordinarily not formed. There are no muzzle impressions around the entry wound.

3. Distant Shots

The nature of wounds in distant shotgun shots depends upon:—

a. The range.
b. The cartridge charge.

c. The site of the head hit.

d. The barrel characteristics.

The shotgun is not effective if fired from long distances. If the range crosses the fatal range limits (which vary with different type of loading), they are ineffective. For example, small pellet charges are ineffective even after forty metres, buckshot charge is not effective beyond hundred metres and only slugs may continue to be dangerous beyond, especially if they are spinning.

The skull is a strong bone. It may resist puncture unless the projectile has sufficient energy to penetrate. Besides, the projectile has to be hard enough not to get disintegrated or deformed on hitting. There are, however, soft sites, which are easily penetrated, like the eyes, ears, mouth and temple. If the victim is hit at these soft sites, the shot is effective.

(1) Indicates the entrance hole.

(2) A radiograph showing location of the projectiles.

(3) Another radiograph showing the complete shattering of the skull and other nearby bones.

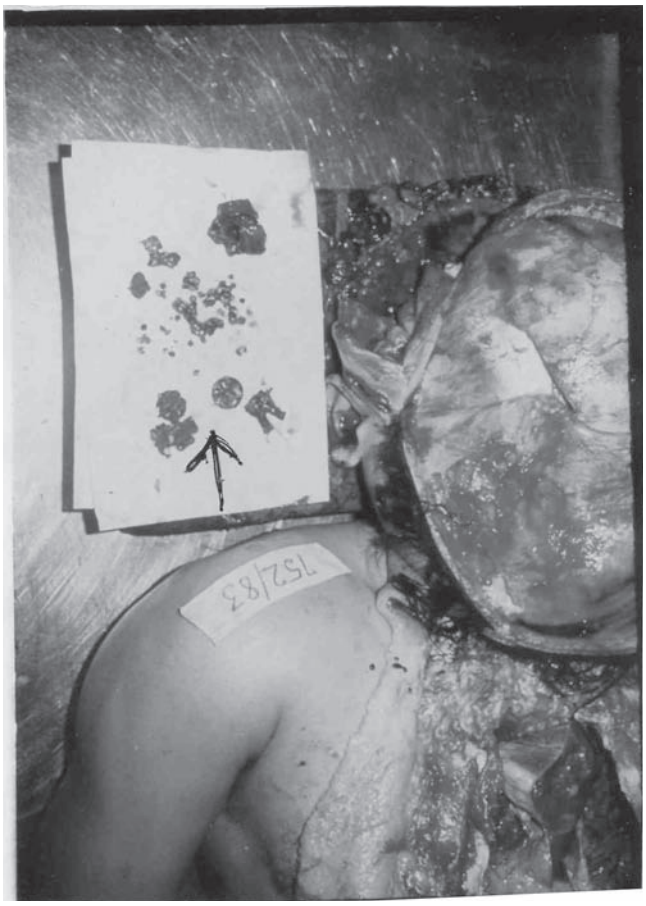


Fig. XVIII-9

Shotgun shot from close range. Whole solid ejecta recovered from the wound.

10.2 Torso Injuries

Torso (the thoracic cavity, the chest, the upper part of the body) is covered by ribcage in the front and spine at the back. It houses heart, lungs and major vascular structures. In the middle, there is trachea, bronchi and esophagus, while the lower ends cover the upper parts of stomach, liver, spleen, and kidneys, etc.

If they are hit and damaged seriously, they prove fatal in the ordinary course. Moreover, the torso does not contain any protective shield like the skull. The torso is the favoured site for homicidal shootings.

Fig. XVIII-10

A rare phenomenon. Pellets could be seen and felt on and around the entry wound. Ribs resistance and small size of the pellets (No. 6) were perhaps responsible.

The shotgun injuries on the torso vary from those of head in the following respects:—

a. There is usually no tearing of the skin even in the contact wounds. Here, the ejecta enter *en masse*. However, in the torso, there is enough space for expansion (and escape) of gases. Consequently, they do not exit from the entry hole.
b. There is only slight blackening around the edges of the wounds in contact wounds. Usually GSR deposits are seen inside the wound. However, in near contact injuries, part of the ejecta including GSR and hot gases come in contact with the skin surrounding the hole and cause close range phenomena (burning, singeing, blackening, tattooing).
c. There are usually no 'explosive' injuries as the ejecta have ample space for expansion inside the torso (unlike head).
d. The wounds are fatal immediately when vital organs like heart/lung/aorta are injured. Even in other organ injuries, if timely medical intervention is not available, the injuries often prove fatal.
e. When the muzzle of the firearm is pressed against the body, muzzle mark is impressed at the site. The close range phenomena is usually absent in such cases.
f. The abrasion collar is wider if the injuries happen to be on the abdomen or on chest, due to greater stretching of the skin.
g. In contact/near contact wounds, the skin and flesh fragments may be found on or inside the muzzle of the gun more frequently. They can link the victim with the culprit *via* the weapon through DNA profiling.

h. In near contact and close range wounds, the close range phenomena (burning, blackening tattooing) is present. The blackening is dense in close ranges (without burning). With increasing range, the density of GSR decreases. GSR may be found up to 1.5 metres, in standard shotgun shots.

i. In contact or near contact shots, the skin around the wound may absorb carbon monoxide to give cherry-red colour. The coloration may be found up to a few centimetres. Sometimes the internal tissues are also coloured likewise.

In distant shots, the projectiles start spreading. With increasing range, the spread increases. The number of projectiles hitting the torso will vary with distance; choke characteristics of the barrel and the angle of fire. The spread of the projectile is used to determine the range.

The wounding effect on the victim will depend upon:—

1. The number/size of projectiles hitting the torso.
2. The striking velocity/kinetic energy of the projectiles striking the target.
3. The energy transferred to the body to cause tissue damage.
4. The affected organ at the entry site.

10.3 Limb Injuries

The limb injuries usually are not fatal if they get timely medical intervention. The shotgun, from close ranges (contact, near contact or powder range), can be devastating, and without medical intervention the victim may die (excessive bleeding, shock, etc.) in the normal course.

The distant shots on the limbs have varying wounding effect, depending upon the range, projectile charge and choke characteristics of the barrel.

Fig. XVIII-11
Through and through:
Entry-Exit (→) wounds

RIFLED FIREARM INJURIES

SYNOPSIS

1. **GENERAL**
2. **RIFLES**
3. **RIFLE AMMUNITION**
4. **RIFLE INJURIES**
   - 4.1 Low Velocity Rifle Wounds
   - 4.2 Sporting Rifle Injuries Wounds
   - 4.3 Service Rifle Injuries
     1. The striking velocities
     2. The constructional features
     3. The firing process
   - 4.4 Intermediate Target
5. **HUMAN TARGET**
   - 5.1 Head Injuries
   - 5.2 Torso Injuries
     1. Contact/near Contact Injuries
     2. Powder Range and the Distant Shots Injuries
   - 5.3 Limb Injuries

19

RIFLED FIREARM INJURIES

Bullet Injuries

(Nutshell)

1. Striking velocity, around 400 m/s (or above): the bullet tends to pass through the body, cutting/tearing/crushing tissues in the path.
2. Striking velocities around/above 1000 m/s, (>600 m/s) the bullet create pressure waves, which:
   a. Dislocate torn tissues.
   b. Create temporary large cavity (10-15 times the diameter of the bullet), which settles down to permanent cavity far bigger than that in '1'.
   c. Initiate shock waves/hydrostatic pressure. They break bones; injure tissues in distant organs from the main path. Liver and brain are easily affected. Lungs/muscles suffer less.
3. Bullets often expand/break/disintegrate to create multiple missiles; damage to the tissues increase manifolds.
4. Bullets may wobble/tumble/suffer yaw, increasing the impacting area of the bullets to inflict devastating injuries.
5. High velocity bullets shatter the bones, creating secondary missiles.
6. Medium velocity (~ 400-600 m/s) bullets usually break/may not shatter the bone.
7. Low velocity bullets break down on striking a bone, the fragments spread and cause grievous injuries.
8. Ricochet from the bones diverts the path of the bullet.

1. GENERAL

An injury may be defined as disruption of the anatomical continuity of tissues. Wounds caused by firearm projectiles are called firearm injuries. The projectiles, striking the human body at high velocities, compress/cut/tear/pulverize the body tissues starting from the entry wound, through its path in the body, to exit wound or to the point where the bullet is lodged, after its kinetic energy is exhausted. If the firearm is fired from contact or near contact range, the shot, in addition, causes burning, singing, peppering, etc. The velocity, the spin, the shape and construction (material, expanding/non-expanding) determine the

extent of the damage of the tissues and lethality. In contact, or close contact, firing high velocity projectiles may cause explosive wounds.

The rifled firearms, commonly used in crimes, are divided into four categories:—

1. Rifles.
2. Pistols.
3. Revolvers.
4. Machine guns.

The military and the civil defence also use these firearms.

The common characteristics of these firearms are that the barrels are rifled. The rifling has twists with varying angles. The calibre of the bullet fired from the firearm determines the degree of the angle of twist. The twist makes the bullet spin in the barrel. Spinning of the bullet continues even after its exit from the barrel. The spin helps the bullet to maintain better aim and range. The spin continues in the target body until its energy is exhausted. Spinning bullets cause greater damage to the tissues. Thus, the rifled weapons are more lethal than their equivalents with smooth bores.

2. RIFLES

The rifles are used in military operations, in sports, in police work and for civil defence purposes. Criminals, especially terrorists, are misusing them increasingly in recent decades in India and elsewhere. The public in India, as a whole, have very few rifles, due to stringent licensing policy for the firearms. Therefore, they are not used much in factional fights, personal vendetta or in other usual types of crimes.

The rifle fires high velocity projectiles. The main features of the rifle, as already discussed, are:

a. They have rifling in the barrel.
b. They fire cylindro-conoidal bullets.
c. They cause small entrance injury of approximately of the same diameter as the bullet.
d. They cause a large exit wound or multiple exit wounds if the bullet fragmented in the body.
e. They cause extensive internal injuries due to cutting, tearing, compression and pulverization of the body tissues.
f. They form both temporary and permanent cavities.

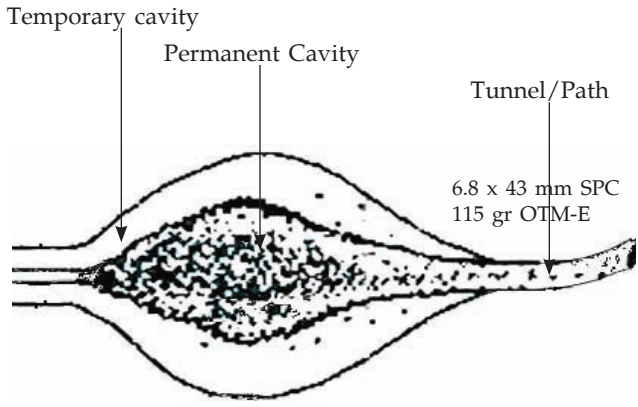


Fig. XIX-1

Cavity formation (Schematic) with a high velocity projectile

The rifling improves both the aim, the range and the lethality of the bullets fired, increasing their effectiveness tremendously.

The rifle, since its induction, has undergone a sea change:—

1. The manual loading system has given way to semi-automatic and automatic actions, which have increased the rate of firing tremendously. Some rifles have a rate of fire over 600 rounds per minute, in bursts of, say, three shots or more shots. The loading and firing is automatic.

   This high firing rate, in bursts, means that the targeted person(s) is likely to receive multi injuries and he has little chance of survival.
2. The capacity of the magazine has also been increased. Most of the service rifles today use a magazine of about 20 to 30 rounds. Some rifles have magazines of larger capacity also. The increased magazine capacity has given the shooter greater firepower. The terrorists are making full use of the power.
3. The recoil was a problem with earlier rifles. It affected the aim (due to vibration and jump) and tired the shooter. In some new rifles, the recoil has been eliminated to a great extent, to overcome the above defects.

   Reduced (eliminated) recoil is a boon to the shooter in military combats or in encounters with the terrorists.
4. The induction of optical sights has improved the aim tremendously.
5. The weights of the assault rifles have been reduced. These rifles are thus more convenient to carry and use in battlefields.
6. The use of night vision devices (fitted in the sights); have made the rifles an effective weapon for night operations also.

3. RIFLE AMMUNITION

The automation of the rifle action has been a great advance in improving the ballistics of the firearm. However, the real revolution, in rifles wound ballistics,

came through the cartridge. It has been modified extensively. The following points are noteworthy:—

1. In olden days, the cartridges were manufactured to aim/fire at a range of one thousand yards/metres or so. Now this range is considered unnecessarily excessive. The firing at that range is seldom required in actual battlefield situations. A more practical range, around 500 metres, is considered closer to real requirement.

   The new cartridges (and firearms) are manufactured to meet this range requirement. The soldiers are now, trained to fire at this range. The muzzle/striking energy of the projectile is adjusted accordingly.

2. The striking energy of a projectile is given by the formula:

   $$\mathbf{E=1/2\ mv^2.}$$

   To increase the energy of the bullet, either the mass or the velocity of the bullet has to be increased. Increase the velocity is the preferred choice. The energy increase is proportional to the square of the velocity:

   $$\mathbf{E \propto V^2}$$

   Increase in bullet weight increase the energy in simple multiple:

   $$\mathbf{E \propto m}$$

3. Almost all service rifles of the world have adopted bullets with smaller calibres lower weights and higher velocities. Thus, the Indian Service rifle using 7.62 x 51 cartridges, have given way to 5.56 x 51 cartridges. The most successful weapon system of the world, AK-47, has also given way to AK-74. The former uses 7.62 calibre and heavier bullet. The latter is using 5.45 calibre and 39 mm long cartridges. The energy of the new generation of the cartridge (bullet, to be more specific) is more!

3. The new cartridges have also changed bullet composition. Former lead core has given way to steel-lead core combinations.

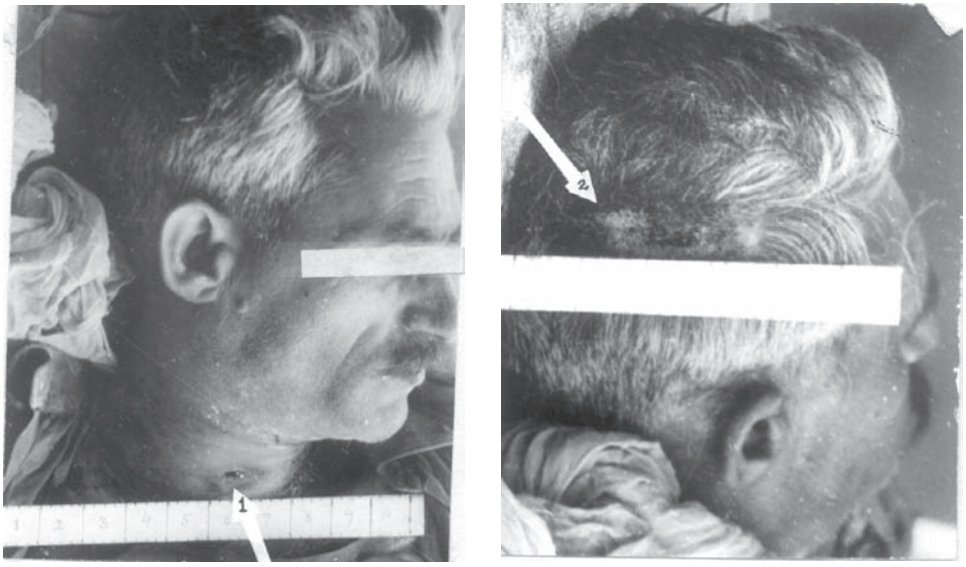
4. The lethality of bullets is ensured by making it an expanding bullet:
   a. A hollow point (tip) breaks/deforms the bullet on striking, to cause devastating injuries.
   b. Thinner jackets at points which ensure the breaking (expansion) of the bullets also cause extensive wounds to the victim.

5. The bullet jackets are also changing. The copper or copper alloys jacket is giving way to steel jacket to ensure proper penetration of the target.

The striking velocity of the projectile is high at all intended ranges. Consequently, the projectiles cause a temporarily cavity which is 10 to 15 times the diameter of the projectile. This cavity causes pulsation, (for about 10 mille-seconds) of the compressed body tissues, which ultimately result in extensive tissue damage. They are cut, compressed, mashed, ruptured and torn. Tissues close to the entrance bullet holes are thrown out sometimes. The body tissues close to bullet path are truly devastated.

High velocity bullets create hydrostatic pressures in the body, which create injuries to distant parts of the body.

4. RIFLE INJURIES



Figs. XIX-2, XIX-3

The sites of entrance (1) and exit (2) wounds give a direction of fire which is ordinarily possible only in a suicide. Trigger was pressed with toe.

The rifles, for the study of the wounding effect, are divided in the following categories:—

1. The low velocity rifles.
2. The sporting rifles.
3. The service rifle.
4. The assault rifles.

4.1 Low Velocity Rifle Wounds

The low velocity rifles are not common in India. One sometimes comes across rifles of .22 and .177 calibres. They are generally imported. The misuse of these rifles in crime situations is rare. .22 rifles are now being manufactured in India[1].

The low velocity rifles usually use rim-fire cartridges. The bullets are made of lead. Sometimes they are copper plated. The bullets usually have low velocities 400 m/s. The weight of the bullet is also low (~2.5 g). These bullets do not fragment, ordinarily. They transfer the total kinetic energy to the target, when they do not come out.

The cartridges used in these rifles are of two types:—

a. Short cartridge.
b. Long cartridge.

1. Indian Ordnance Factory; see appendix to chapter 2.

The short cartridge has low power. The long cartridges are more powerful.

The cartridge for these rifles has smaller amount of propellant charge and the projectile has less weight. Consequently, on firing, it develops low pressure, low velocity and less kinetic energy. Consequently, the projectile causes less damage to the body tissues The GSR deposits around the injury and combustion gases produced are also limited. They often do not create star-shaped injuries. The projectile seldom forms exit injury.

The contact or near contact, injuries of such rifles/ammunition have the following characteristics, generally:—

1. When the weapon is pressed against the skin, it leaves muzzle impression on the skin around the entrance hole.
2. The contact injuries are clean small round or oval holes. The GSR is easily identifiable with the Scanning Electron Microscope, with or without EDX. It may not be so easily identifiable visually due to the small amount of the GSR.
3. The head injuries may have star-shaped skin tears, though they are often absent. Usually the bullet does not form an exit hole. The long and magnum .22 cartridge bullets may create exit wounds.
   The skull may/may not be fractured.
4. The injuries on the other parts of the body may have through and through holes. However, if some bone comes in the path, the projectile is retained. Often the bullets, in the latter cases, are deformed and fragmented and no exit wounds are formed. The short cartridges usually do not form exit holes.

The powder range, up to which GSR can be detected, varies with the types of cartridges, the nature of the powder charge being the main determinants. The ball type of propellant has spherical shape. Unburned/semi-burnt particles may travel to a long distance (compact size!). The GSR may be found, in decreasing quantities, up to about 75 cm.

The injuries produced in the powder range are no different from those produced in the near contact range except for the quantity of the GSR deposited in and around the injury, and for the absence of the scorching, which the hot gases cause when firing is from contact/near contact range.

The quantity of powder and the burning of the skin or flesh at the injury site differentiate between the contact and the near contact injuries. At extreme powder ranges, sparse tattooing is observed.

The injuries at long ranges **(**one metre or beyond**)** have the following characteristics:—

1. The GSR is absent.
2. The entrance holes are slightly smaller than the diameter of the bullets if the injury happens to be at a pliable site. They are sometimes mistaken for a pellet or an ice pick injury.
3. The soft/hollow point bullets break up and mushroom even without meeting a bone when fired from a close/intermediate range.
4. The bullets usually do not fracture bones.

4.2 Sporting Rifle Injuries Wounds

The hunting as a sport is not very popular in India for a number of reasons – mainly for religious and legal restrictions. The presence of sporting rifles is, therefore, not common, especially in crime situations. The author has come across only a few crime cases, which involved sporting rifles. The firearms had double barrels, one 12-bore barrel and the second, a .315-rifled barrel. Often, only the 12-bore barrel had been used.

Sporting rifles of .30 and .315 rifles are being made in India now.

The functioning of sporting rifles, excluding the air rifles and low velocity rifles firing rim-fired cartridges, corresponds to that of the service rifles.

The sporting rifles and hence their ammunition is not common in India.

The sporting rifle ammunition has some characteristics, which necessitate their separate consideration.

1. The sporting rifle projectiles are mostly expanding bullets. They mushroom and break up. The expanding effect is achieved through any one or more of the following features introduced in the construction of the bullet:—
    a. The tip of the lead core is exposed. The bullet is known as a soft point bullet. The designs vary with different manufacturers.
    b. The tip is made of softer material. Aluminum, polycarbonate, bronze, brass has been used.
    c. The tip is hollow to allow expansion. It facilitates mushrooming and breaks up.
    d. The jacket has difference thicknesses at various points. The bullet breaks up at the places on entering the target where the jacket is thin.
2. Some of the sporting rifle bullets have high velocity (1600 m/s) like service rifle bullets.

Both these characteristics of the sporting rifle projectiles make them extremely powerful. They create devastating injuries on the human targets. The injuries are no different, qualitatively, than those of the other high velocity service projectiles as far as burning, blackening, tattooing and other characteristic formations of the wounds are concerned but these injuries differ in the internal damage and also, in some cases, in the shapes and sizes of the exit wounds. The varying features of the injuries between hunting rifle projectiles and high velocity service rifle projectiles include:—

a. The fragmentation of the bullets (of the core in most of the cases and of the jacket in some cases) makes the bullet a multiple projectile device inside the body, which causes extensive multiple wounds from a single projectile.
b. The skull at close ranges (contact, near contact, powder ranges) is fractured at many points and pieces may blow off in some cases. Usually, the exit wounds are formed but they are seldom established with certainty.
c. The brain matter is pulverised to a pulp, and is scattered around.

d. The distant shots from all the effective ranges, cause extensive damage, far more severe than those from the high velocity service projectiles, due to fragmentation of the projectile.

e. The entrance wounds have the usual sizes and appearances, corresponding to those of the service rifle bullets.

f. The exit wounds, due to the fragmentation of the projectile inside the body, do not correspond to the usual pattern of the high velocity projectiles. The wounds are of course irregular. However, the sizes and the number vary. There may be no exit wound even.

g. The X-rays are used to locate fragments of the hunting rifle bullet in the body, like those of other high velocity expanding bullets.

h. If a high velocity hunting rifle bullet passes through an intermediate target, the bullet may break up into parts. The fragments may form two or more entry wounds from one projectile. In some cases, they can cause confusion about the number of shots. This does not happen usually with other high velocity service projectiles.

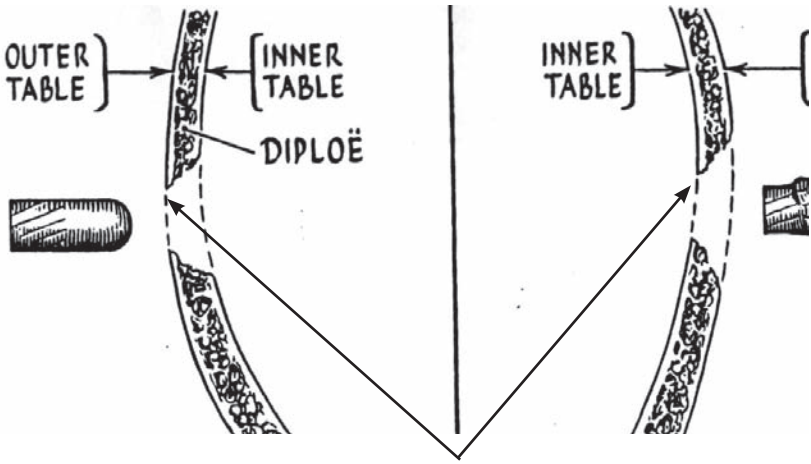


Fig. XIX-4

Entry/exit craters
Bone Beveling/crater formation
Through and through rifle bullet injuries to skull

4.3 Service Rifle Injuries

The service rifles are the firearms used by the services (the armed forces, para military forces and police forces) of all countries. The criminals, especially the terrorists also use them.

The modern service rifle ammunition has the following important features affecting wounding:—

1. The bullets are fully jacketted with copper, cupro-nickel alloy or steel sheet. USA Service ammunition bullets (– M-885) and the Russian AK 74 have steel jackets. The steel jacket ensures proper penetration.

2. The bullet expands inside the body and increases the lethality of the bullet many times.
3. The core is made of steel and lead to ensure proper sectional density and stability (the steel core does not fragment). Both help adequate penetration and destruction of body tissues.
4. The lead core squeezes out and cause extensive damage to the tissues.
5. The muzzle velocities are in the range of 700 to 1000 m/s. The muzzle velocity of bullet of the new Indian service ammunition is 910 m/s. This velocity ensures adequate high striking velocity at all practical ranges to cause extensive wounds.

Figs. XIX-5, XIX-6

Typical small round entrance wound and a key-hole exit wound - a rifle bullet shot.

6. The wounding power depends upon the quantum of kinetic energy transfer to the body. The factors, which influence the wounding, are:—
   (1) The striking velocity of the projectile.
   (2) The constructional and compositional features of the projectile.
   (3) The firing process.
   (4) The intermediate target.
   (5) The target.

1. The striking velocities

The striking velocities at the effective ranges (up to 500 m) are high because the service rifles have muzzle velocities in the range of around 1000 m/s. Usually, they cause explosive wounds which are characterised by the usual small entrances, extensive internal damage and the big rabbit (rather than rat) holes.

2. The constructional features

The important constructional and compositional features of all the service rifle bullets are:

a. They are fully jacketed; consequently, they ordinarily do not break except the US service rifle (AR-15/M-16 AI) bullet which, though fully jacketted, yet it has a cannelure almost at the midpoint. The bullets break at this point, and the lead is squeezed out. It spreads in the tissues and thus transfers most of the kinetic energy Because of this expansion of the projectile to the body. The lead, in the X-rays photograph, looks like a whitish cloud, called 'lead snow storm'. The bullet, is called 'exploding bullet', though the projectile does not contain any explosive material. It explodes because of its structural features and high velocity.
b. The cores of the service rifle bullets are usually made of lead but there is an increasing tendency to introduce a steel core along with the lead core. The steel core does not break and helps better penetration. The lead core helps expansion and hence greater transfer of energy to cause devastating damage.
c. The shape of the projectile is usual conoidal, with a pointed nose (spitzer shape). In some service rifle, bullets the base are boat tailed.
d. The bullet tips have received special attention. In some cases, it is hollow. In other cases, soft material forms or fills the tip. The tip and the jacket are responsible for its deformation and fragmentation.
e. The dimensions of the bullets are around 5.56 x 45 in most of the service rifle. The Russian rifle bullet is 5.45 x 39. The bullets weigh 3.5 to 4 g each. The older service rifle bullets are still in vogue in some countries. These bullets weigh about 8 g each.

3. The firing process

The firing process ensures that the bullets acquire the required velocity, adequate spin and is not deformed. They maintains proper aim/velocities/

kinetic energy transfer at various ranges. The higher velocities require greater spin to maintain the proper aim and range. Increased twist increases the spin and maintains proper ballistics of the bullet.

The distance from which the projectile is fired determines:—

(1) The striking velocity.

(2) The influence of the ejecta, other than the projectile, on the target.

(3) The stability of the bullet in flight (wobbling effect in the initial/final stages).

4. Angle of fire determines the range of fire and correct aim. If angle of fire is below the critical angle for ricochet, the projectile will ricochet and may not hit the target.

4.4 Intermediate Target

Intermediate target has the following effects on the ballistics of a bullet passing through it:—

1. If the bullet passes through the target undamaged, there is loss of some energy but there will be no major changes in the wound ballistics.
2. If the bullet is deformed, the entrance wound would be irregular and the injury may be severer, due to greater transfer of the kinetic energy. The aim is also affected.
3. If the bullet is destabilised, the wound will be irregular.
4. If the bullet is broken into parts, the fragments may form individual multiple injuries, usually irregular in nature.
5. If the intermediate target is fragmented, the fragments may act as secondary missiles and hit the body causing injuries or peppering, if the target is close to the intermediate target.
6. The intermediate target may absorb most of the energy and thus, reduce the wounding power of the projectile considerably.
7. If the bullet strikes the intermediate target at a low angle, the projectile may ricochet.
8. The intermediate target may absorb all the energy (bulletproof vests etc.) and make the projectile ineffective.
9. If there are two intermediate targets, the phenomenon of 'back-scattering' may occur when the bullet strikes the second target. The GSR and the lead vapours from the projectile may be deposited on the exit side of the first target, which may cause confusion to the novice or the nonprofessional.

5. HUMAN TARGET

The site hit has important bearing on the extent of the damage of the body tissues. The injuries have been discussed in respect of the three major anatomical parts:—

1. The head.
2. The torso.
3. The limbs.

5.1 Head Injuries

The head injuries by service rifles have varied features:—

1. Contact Head Wounds:

The contact head wounds have the following features:

(1) The contact or near contact service rifle shots usually blow off the head, rupturing the skull, creating fractures and tissues at a number of places. The wounds are usually large and irregular. The damage gives the appearance as if some explosion has taken place inside the head. Both the gases and the pulsations caused by the bullet are responsible for the 'explosive' effects. The extensive damage to the head includes blowing off the head.

(2) The exit wounds are usually big holes.

(3) Ordinarily the star-shaped tears will be present when the entrance injury is visible. The close range phenomena: burning, blackening, tattooing, due to the hot gases and the GSR, are frequently present around the entry site. They are also found inside the wound, even up to the exit wound, as the body materials are pushed, the GSR may follow to the exit point in some cases.

(4) If the rifle is fitted with a recoil or flash suppresser, part of the gases and GSR are diverted:

a. They reduce the severity of the damage by the ejecta.

b. They produce characteristic burning, blackening and tattooing patterns around the wound where the gases impinge. The marks are well defined on the skin at the sites corresponding to the flash/recoil suppresser holes.

2. Near Contact Wounds:

The near contact wounds of the head, up to 10 cm, are practically similar, though they may be slightly less severe and carry greater GSR deposits and burning of skin around the wound.

Prominent Entry Wound Features

1. Circular in straight shot.
2. Oval in angular shot.
3. Inverted margin.
4. Dirt ring around the hole.
5. Abrasion around the edges.
6. Contusion around the injury.
7. Stellate (star-shaped) skin tears around the hole, starting from the edge.
8. Key hole shape injury by unstable/tumbling bullet.
9. Charring/burning of skin by hot gases from contact/near contact range.

10. Blackening/tattooing/stippling up to powder range (~ 1 m) shot.
11. Contact/near contact head injuries may be explosive wound.
12. Grazing/cut injuries in grazing shots.
13. Ricochet of bullet from head in low angle (~ 10 to 200) fire.
14. Single bullet may produce multiple entry wounds (multiple entry wounds are due to separate entrance wounds of jacket and core from same bullet).
15. Intermediate target may fragment bullet to create/produce irregular multiple entry wounds.

3. Powder Range:

The powder range of the service rifles is up to about 1 metre. The powder range wounds of the head are comparatively less severe because the gases do not enter the body beyond the near contact range. Consequently, the blast effect of the ejecta does not contribute to the severity of the wound. However, the high velocity projectiles continue to play havoc and cause 'explosive' wounds. The powder range wounds have the following features:—

a. Ordinarily, the wound is explosive and the head is shattered.
b. The entrance wound is usually not destroyed in the 'explosion' though the exit wound may be so large that the usual exit wound characteristics except for the eversion of the edges may not be visible.
c. The entry/exit wounds have beveling of the skull bone.
d. The GSR deposits are available around the entrance holes, though the density of the deposit goes on decreasing with the increasing range.
e. The maximum powder range depends upon the nature of powder, its age, burning characteristics, size, shape, etc. It is somewhat affected by the firing mechanism and the barrel length of the rifle.
f. Intra-oral, contact, near contact and the powder range wounds are devastating wounds like those of contact shotgun wounds.

4. Distant Rifle Head Injuries:

The distant rifle head injuries, up to the effective range limits, have the following characteristics:—

(1) Clean entrance holes without deposits, though contusions and sometimes the dirt rings are present.
(2) There is an 'explosive' wound inside, if the striking velocity is more than 600 m/s. There are extensive variations in these explosive wounds, depending upon:—
    a. Projectile characteristics: expanding bullets cause greater damage.
    b. The site hit: thicker the bone at the site, greater is the bullet instability, and hence greater is the damage at all practical ranges.

In 'explosive' wounds, the 'blowing off'/shattering of the head is extensive. Sometimes it needs careful reconstruction to locate and identify the entrance/exit wounds.

5.2 Torso Injuries

As a contrast to the head, torso has ample spaces for the gases to expand inside. Consequently, the explosive effect of the blast is absent. The major features of the torso injuries are:—

1. Contact/near Contact Injuries:

The contact/near contact injuries have entrance wounds, which look normal. The main features are:

(1) They may carry, in addition to muzzle impression, the impression of the foresight.

(2) They have specific burn patterns from the flame and hot gases if a silencer or recoil reduction device is used.

(3) They carry the usual close range phenomena. Burning, blackening, tattooing, etc. are present.

(4) The absorption of carbon monoxide, as evidenced from the cherry-red colouration of the skin/flesh around the hole is often seen. The carbon monoxide effect may also be present on the flesh en route to the exit hole.

(5) The internal injuries have like head injuries, extensive damage to the tissue in the track and surrounding areas.

(6) The exit wounds, like head injuries, are many times the diameter of the bullet. They are irregular. The body tissues may protrude.

2. Powder Range and the Distant Shots Injuries:

The powder range and the distant shots injuries within the effective range, vary in respect of GSR deposits. The former have deposits around them. There is no deposit around the latter.

The main features of these injuries are:—

a. The exit wounds are generally many times larger than the bullet diameter.

b. They are irregular.

c. The internal injuries are devastating from not too distant shots.

d. The abrasion ring is large.

e. The radiating ($\leq$ 5 mm) around the hole may be seen in some cases.

5.3 Limb Injuries

Fig. XIX-7

Through and through:

Entry-Exit (→) wounds

Rifle injuries on the limbs are injuries on hands, arms, feet, legs and thighs. Here the projectiles traverse only short distances and often exit. The passage is through muscles and through bones.

The following characteristic features of the limbs injuries are noteworthy:—

1. They are usually through and through injuries – bullets are not retained.
2. The bullets usually do not break; except when they strike thick bones.
3. The temporary cavity formation is limited, because the path traversed is limited and the compression is for a limited time.
4. Close range phenomena (burning, blackening, tattooing etc.) are present in contact, near contact or powder range wounds. There are no other substantial differences in close and distant range shots.
5. The fracture of leg bone prevents the subject from running away. The police often fire on the legs of the criminals who try to run away from the police.
6. The limb injuries are not fatal if the subject gets medical treatment, in time.

7. Single bullet may produce multiple entry and exit wounds due to separate entrance wounds of jacket and the core from same bullet, fragmentation or intermediate target creating secondary missiles.
8. Fragmentation of bullet and intermediate target may produce irregular entrance wound.

Exit Wounds Characteristics

1. Irregular shape.
2. Everted margin.
3. Intact rifle bullet create large rat-hole wound of stellate shape.
4. Fragmentation of bullet in the body may cause multiple exit wounds for a single entry wound.
5. Secondary missiles (broken bone pieces or fragments from intermediate target) may give multiple exit wounds.
6. No charring/singeing/blackening/tattooing/stippling, ordinarily.
7. No dirt ring/abraded collar/contusion, usually.
8. Shored exit wound shows abrasion around exit wound.

HANDGUN INJURIES

SYNOPSIS

1. HANDGUN INJURIES
- 1.1 Contact Wounds
- 1.2 Powder Range Injuries
- 1.3 Distant Shot Injuries

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HANDGUN INJURIES

Fig. XX-1

Auto 9 mm: Sidearm of Indian forces

The common handguns, excluding improvised firearms, are pistols and revolvers. Most of them fire low velocity projectiles, up to about 400 m/s; usually, the muzzle velocity varies from 200 to 400 m/s. The jacketted bullets and jacketted bullets are used in automatic and semi-automatic pistols. Un–jacketted lead bullets are used in revolvers.

The bullets have usually round nose, which is less efficient for penetration, but more efficient for kinetic energy transfer to cause greater tissue damage to the subject, due to the greater presenting area it offers to the target.

The common calibres in handguns encountered in India, are:—

1. 6.35 mm (.25)
2. 7.65 mm (.32)
3. 9 mm (.38)

Formerly, the .44/.45 revolvers were also being used. They are now a vanishing creed.

The handguns are personal defence weapons. The usual barrel lengths of the weapons vary from 5 to 15 cm. They are meant for close range firing (~ 25 m) only, though some pistols can be converted for long range firing also. For example, German Mauser can be used as semi-automatic pistol, automatic pistol or as a shoulder firearm. The aiming range of handguns is usually low, though the killing range, *i.e.*, without aim, is tremendous. A hit, even from a long range (> 500 m) can kill a person easily if it strikes the person at vital organs.

The handguns fired from the intended ranges, may create through and through injuries, having an entrance, an exit and a tunnel path in between. The small calibre handguns form only entrance wounds. There are usually no exit wounds. The handguns do not form explosive wounds. However, in some cases when the bullets, especially lead bullets, come against bone and fragment, the damage may be extensive. The bullet fragments create multiple secondary projectiles, going in different directions and may form, in rare cases, multiple exit wounds. Besides, the breaking up of the bone creates secondary missiles to cause more extensive wounding. The lead bullets may not create exit holes.

The use of standard handguns, excluding *Kattas* (locally manufactured crude handguns), which can be used only for a limited number of firings, is not extensive in India. The standard handguns are very costly and the licences are given only to the selected few. They are not involved in many criminal cases. The terrorists and the organised criminal gangs smuggle/purchase the guns from clandestine market and are using them in their activities increasingly.

1. HANDGUN INJURIES

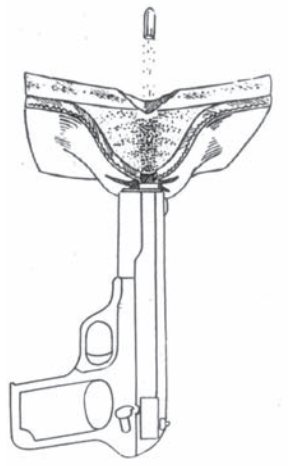

Fig. XX-2

Mechanism of formation of star shape skin tears. The gases get into the space between the bone and skin and cause tears.

The nature of injuries of the various handguns, (both pistol and revolvers) are almost similar. There are only minor quantitative differences in the wounding effect. Their injuries have been discussed together.

Fig. XX-3

Can a .32 pistol bullet cause devastating blast effect?

Yes, it has! The muzzle of the pistol was in the mouth when fired!

1.1 Contact Wounds

The contact wounds from the handguns have the following characteristics:—

1. They create muzzle impressions at the site if the firearm is pressed against the site at the time of firing.
2. The head injuries from the contact on near contact ranges generally tear the skin around the wound, to give star shaped injuries. The dimensions, of course, vary. The 6.35 revolver may not tear the skin and form star shaped injuries. On the other hand, an angular shot may tear the skin even from a distance.
3. In star-shaped injuries, the surface from which the skin is separated, is usually covered by GSR particles. They can be observed on the under surface by lifting the torn skin.
4. The partial muzzle impressions are found if the muzzle is held pressed at an angle or it is pressed against a curved surface. In such cases, the GSR will escape from the gap. It is deposited on the skin. The gap and the angle of fire affect the shape of soot pattern.
5. Most of the ejecta enter into the body along with the bullet.
6. The GSR particles deposited around the wound are sparse, when most of the ejecta go inside the wound. It may not be easily discernible in some cases. Stereomicroscope, with a movable side arms, (dissecting microscope), helps. Scanning Microscopy, with or without EDX is the ultimate decider.

7. The GSR particles are covered by blood, blood clots or even by the haemolysed blood, sometimes. The doctors may not be able to detect them easily. However, an analyst can detect/identify them though chemical/instrumental analysis.
8. The GSR particles are found around the entrance hole. They are, usually, in small amounts.
9. The GSR particles are found deposited on flesh along the bullet track, in contact/close contact wounds.
10. The skin/flesh around the injuries absorbs Carbon monoxide to give cherry-red appearance. If the colour is masked, the absorbed gas is detected through chemical/instrumental methods (gas chromatography!).
11. The handguns, especially revolvers, give out semi-burnt/unburned powder particles in the GSR, in substantial quantities. They may travel through the internal track to the exit wound. This happens in contact/near contact wounds only. Heavy powder loads, ball type of propellant and aged ammunition promote the production of these particles.
    The light particles of the GSR usually do not reach the exit wound.
12. GSR often escapes visual detection, as the deposits are sparse. The wound would be mistaken for a distant shot in such cases. Chemical/instrumental analysis rectifies the mistake.
13. When the body has putrefied or the wound has dried up, pseudo GSR particles may mislead the medical examiner that the shot is within powder range, though it may be a distant shot.
14. In some contact shots from handguns on the torso, the contusion ring may be wider.
15. The contact shots from handguns though cause severe injuries, yet they do not burst open the head/skull, like rifle/shotgun injuries. Some large calibre firearm and heavy powder charge, in rare cases, may burst the skull.

Fig. XX-4
1. Contact .32 revolver wound.
2. Corresponding exit wound suicidal death.

16. Sometimes, the powder particles adhere to the projectile fairly strongly. They are not burnt, do not fall en route and travel along with the projectile far beyond the powder range, and are wiped off at the entrance wound. They can mislead the novice. They are discriminated from those of close range phenomena:
    a. Their number is seldom more than two or three particles.
    b. They are not impregnated into the skin. They are just wipes at the edge of the wound.

1.2 Powder Range Injuries

As the name indicates, the powder range injuries are from a range up to which GSR is deposited on the target (~1 m). The nature, shape, size, quantity and the age of the powder determines the range.

Whenever the determination of range is required, it is done experimentally. Test patterns are obtained using the same firearm and similar ammunition; same batch ammunition of the same manufacturer is preferred.

The density of GSR deposits is a function of the range and of the various characteristics of the powder. Therefore, only actual test firing with the suspected firearm and similar ammunition and comparison of obtained pattern gives the correct range.

The distinction of powder range injuries from close range injuries may be noted:—

1. The density of the powder deposit goes on decreasing with the increasing range.
2. The velocity of GSR particles fall rapid decreases. Sometimes they do not penetrate through clothes to reach skin. However, the GSR particles do pass through the hole created by the bullet, when they have enough velocity to do so (> 1 m). Likewise, they seldom enter the track unless pushed by the bullet.
3. Cherry-red coloration, due to carbon monoxide absorption, range is less than 30 cm.
4. The range, the nature of the powder and the angle of fire are mainly responsible for the shape and size of GSR spread patterns in normal firearm-ammunition combination. Combustion of the propellant and barrel length of the firearm determine GSR range and its density.
5. Tattooing does not take place on the palmar surfaces of the hands/feet, though some unburnt/semi-burnt particles may be found sticking in close range bullet injuries to the palmar surfaces.

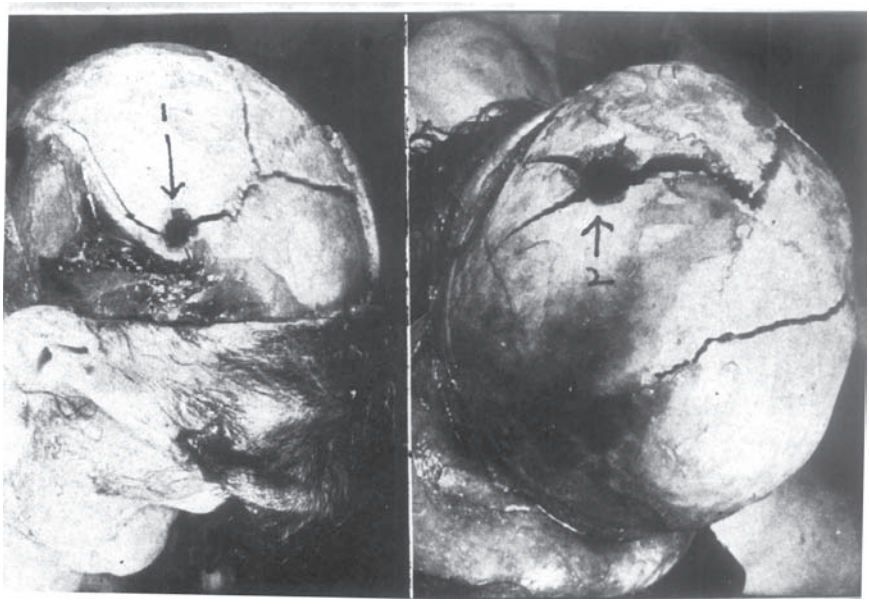

Fig. XX-5
Typical entrance/exit wounds from a high power handgun on skull bone.
1. Entrance 2. Exit with crater formation, larger size, multiple fractures.

1.3 Distant Shot Injuries

The shots from beyond the powder range (> 1 m) are distant shots for the purpose of this discussion. The main discriminating features of these injuries from those from the close range injuries are:—

1. The entry wounds do not possess stellate shape.
2. The entry wounds do not have GSR deposit or tattooing around the injuries.
3. The injuries are less severe than those from the close-range fire. The extent of the damage varies with actual range. But the injuries up to the effective ranges (with aim), are almost alike *inter se*.
4. Range determination from entrance and exit injuries, in angular fires cases, is possible.

   In a murder case, the prosecution story of the occurrence was that the deceased and the accused were standing at the time of occurrence, on their respective roofs across the street. The street was three metres wide and the roofs were at the same level. The accused fired a pistol shot and killed the victim. The wound of exit on the back was 5 cm above the level of the entrance wound on the chest.

   The defence filed an appeal against conviction, challenging the version. It produced a bust and a long probing rod with which they showed that the line of fire met the roof level at about two metres from the site position of the victim. The defence argued that the accused, therefore, could not kill the

victim, as he was at least a metre away from where the line of fire met the roof level.

A careful study of the heights of the deceased, the accused and the positions of the entrance and exit wounds and the thickness of the body was done. It was shown, both mathematically and with the help of a graph paper that firing and killing was possible from across the street.

The defence in their demonstration had decreased the body thickness and increased the height of the exit wound. The angle of the line of fire was thus increased and the line met the roof level only at about two metres away from the victim. (CH)

5. Range determination is also possible from the consecutive bullet marks at the scene from an angular fire.

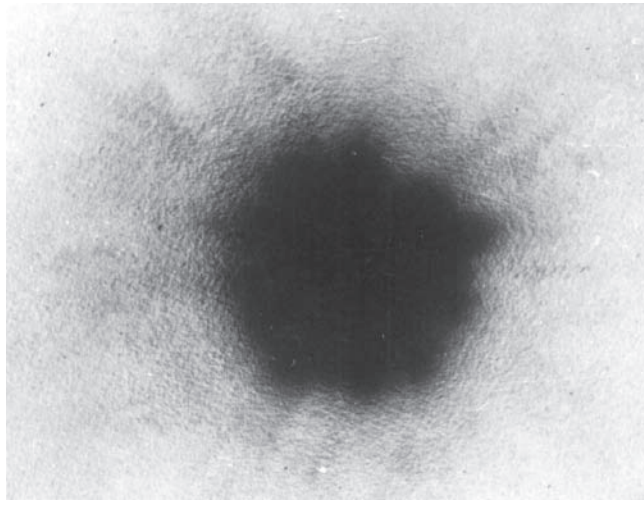

Fig. XX-6
Powder pattern from close range.

RECONSTRUCTIONS OF SHOOTING INCIDENCES

SYNOPSIS

1. GENERAL
- 1.1 Smokeless or black powder?
- 1.2 Two or four shots

2. POSSIBILITIES

3. RECONSTRUCTION
- 3.1 Basics
- 3.2 The Reconstruction Expert

4. DATA FOR RECONSTRUCTION
- 4.1 Visit to the Shooting Scene
- 4.2 IO's Documentation
- 4.3 Photographs of the Scene
- 4.4 Clothes of the Victim
- 4.5 Post-mortem or Medico-legal Report
- 4.6 Arms and Ammunition
- 4.7 Basic Ballistic Facts
- 4.8 Ricochet Bullets
- 4.9 Demonstration
- 4.10 Court's Participation
- 4.11 Expert's Performance
- 4.12 Crime Scene Reconstruction and Presentation

5. SOME NOVEL SHOOTING RECONSTRUCTIONS
- 5.1 Gang War
- 5.2 Onus of murder
  - A. The brief facts of the case
  - B. Forensic Experts' findings
  - C. Closed Window
  - D. Appraisal
  - E. Other Evidence

6. ADVANCING FRONTS IN SHOOTING RECONSTRUCTION
- 6.1 Virtual Reality Animation
- 6.2 Computers in Sketching Shooting Scene
- 6.3 Global Positioning System (GPS)
- 6.4 Computer-Aided Design (CAD) Software
- 6.5 Flight Path Bracket (Trajectory Determiner)
- 6.6 Geospatial Technology
  1. Specialized Storyboards
  2. Global Imagery
  3. Metadata and Media Source

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RECONSTRUCTIONS OF SHOOTING INCIDENCES

(Who/Why/Where/When/What/How?)

Suicidal Shooting Indicators

1. Choice of the suicide site: closed bedroom/bathroom.
2. The shooting scene: mainly undisturbed, bullet marks may exist, if it exits.
3. Presence of firearm in prone position: around hand, near/on the body.
4. Injury at preferential suicidal sites: temple, mouth, forehead, under chin, chest.
5. Contact/near contact/powder range firing; ejecta in/around the wound: contact suicidal shots in over 97.9 % cases; powder range shots in about 2 % Cases;(US Stats).
6. Presence of burning, blackening, tattooing, muzzle imprint, dirt/ contusion/abrasion rings.
7. GSR on the hand (that fired the gun), face, clothes.
8. Suicide note (in about 30 % cases).
9. Facing serious social problem: financial/familial/business or social problems including sexual harassment, kidnapping, and the like.
10. Health problem/fatal disease/incapacitation/loneliness/ alcoholic/drug addict.
11. Psychological autopsy: suicide inducing environment: family (violence/strain), office worries, quarrelsome neighbour or suicidal tendencies.

1. GENERAL

Reconstruction of a shooting incident is to find out how the incident took place. *Inter alia*, it helps to establish whether the given occurrence is accident, suicide, homicide or a killing in self-defence. It is assuming ever-increasing importance. This is mainly because the courts are accepting fired ammunition-firearm linkage as definite and beyond doubt, routinely. The defence, therefore, tries to show that the shooting was in self-defence, an accident, or a suicide and

not a homicide. The defence counsels have perceived the subconscious attitude of the judges. They now try to convince the court that the given shooting incident is a case of suicide/accident/self-defence. They put up their thesis before the courts. The verification of the thesis for authentication/contradiction through experiment or evaluation of available data assumes great importance. The two cases given below, one simple and the other a bit complicated, illustrate the importance of professional reconstruction of the incident.

Shooting incidents provide numerous evidentiary clues. Principally they are firearm/fired cartridge cases/projectiles/primer residue, GSR/projectile flight paths/tidbits around surrounding area/holes on the intermediate target, the victim, broken glass/projectile wounds on the victim/projectile marks on furniture at the scene/struggle marks on the culprit/victim/site, etc. The culprit also provides many clues, like GSR/injuries, etc. They prove helpful to reconstruct the shooting incident.

The evidence available from the scene/victim/culprit/firearm/ammunition/circumstances is used to reconstruct the incident.

Some examples:

1.1 Smokeless or black powder?

In a case of murder, the powder marks were observed even on the skin. The shot had passed through one sweater, one shirt and one under-vest. A 16-bore shotgun had been used from less than a metre. The projectile charge had entered the body en masse, after creating holes in the garments.

The defence counsel noted that the cartridge contained smokeless powder. He also located a book on medical jurisprudence in which it was mentioned that blackening is caused by black powder. He got it confirmed from the medical witness that he agreed with statement in the book. He also said on asking that the smokeless powder does not cause blackening.

When the author appeared for evidence, the shrewd defence counsel asked just one question:

Did the crime cartridge, involved in this case, contain smokeless or black powder, as propellant?

The counsel was informed that the cartridge involved contained smokeless powder. The council thanked the author and did not ask any other question.

At the time of arguments, the defence counsel said that the cartridge, in question, contained smokeless propellant (per ballistics expert); the deceased received injury from a cartridge which contained black powder as there was profuse blackening (per medical witness). Therefore, his client was not the killer.

The argument appealed to the judge. He acquitted the accused.

The prosecution was upset. On the advice of the author, they filed appeal in the high court. The court called the author assist the court. The author took the same gun and the ammunition recovered from the accused. He fired three shots from the alleged range, on test target, in the presence of a court official:

1. *One shot on a white filter paper*
2. *Second shot, again, on another filter paper, after covering it with the clothes the victim was wearing at the time of being shot.*
3. *Third shot was fired on a brown (to simulate skin colour) paper after covering it with the deceased clothes.*

The three target papers were submitted to the court. All of them had plenty of blackening in them. The court did not time to reverse the judgment and convict the accused. (CH)

1.2 Two or four shots[1]

In a case of murder, the culprit fired two shotgun shots at the victim in broad day light on a railway station. The victim died immediately. Many persons saw the killing. They caught him red-handed with the smoking gun and handed him over to the police.

The case, after completion of the investigation, came up in the court. The court found the accused guilty and convicted him.

The accused appealed against the conviction. The defence plea was that the medical evidence was at variance with the eyewitness accounts. There were four sets of entrance wounds according to the medico-legal officer. The eyewitnesses had stated that the convict had fired only two shots. The defence counsel argued that even if we accept that the convict fired two shots, some other person fired the other two shots. There is no reason the killer shots were not fired by the unknown person. The convict, therefore, must get the benefit of doubt.

The appellate court sent the case to the author to ascertain whether the given injuries were caused by two or four shots. The following observation/experiments were performed:

1. *The crime weapon was a standard 12-bore DBBL shotgun, one barrel was cylindrical, and the other was choked.*
2. *The cartridges fired contained LG shots*
3. *The injuries found by the doctor were:*
    a. *3 grazing injuries on the left shoulder (Injury No, 4). Nitrite particle were discovered on the shirt, the intermediate target.*
    b. *One (No. 1) injury just above the left ear. The wad and two LG shot had been extracted from the injury. It indicated a close range shot. Part of the charge had not entered the body*
    c. *Two (No. 2, 3) through and through injuries (entrance and exit) below the jaw bone*
    d. *Injury (No. 5) A single entry hole of about 1" diameter. It was a shotgun injury from close range where the full ejecta of a 12-bore shotgun LG cartridge had entered the body en masse*

Extensive experimental firing was done with the suspect's firearm and similar ammunition, on inanimate bust models, from various close and intermediate ranges

1. Reported case: *Om Prakash* v. *State of Haryana,* 1971 Cr LJ 1109: AIR 1971 SC 1388.

and at different angles. The pattern of the injuries could be duplicated from a range of about one to three metres on varying the angles of fire. The representative patterns on the models were exhibited in the court.

The Apex Court (SC) accepted the reconstruction with the following remarks[1]*:*

> ***"We have given our most careful consideration to the medical evidence in the light of the above quoted authorities on medical jurisprudence, the deposition of Dr. B.R. Sharma and the contention of Mr. Sibal and our conclusion is that the latter cannot prevail and that the opinion of the ballistic expert, substantially in accord as it is with the said authorities, deserves acceptance."***

The conviction was maintained. (CH)

Fig. XXI-1

A typical suicide scene, confirmed by suicidal note.

2. POSSIBILITIES

The reconstruction of a shooting incidence helps to ascertain many facets of the incident including the following:—

1. If the shooting scene is real or simulated.
2. If the incident involves shooting.
3. If the firearm injury is real or fake injury.

1. *Om Prakash* v. *State of Haryana*, AIR 1971 SC 1388. Extracts in chapter 24: Case Law.

4. If the given prosecution/defence version is correct.
5. If the shooting incident is a case of suicide, forced suicide or simulated suicide.

   A group of scientists, in USA, carried out a survey of 1704 cases of suicidal firearms deaths in 2001. They found:

   (1) The firearm[1] used were:
      a. *Revolvers in 49.8% cases*
      b. *Automatic pistols in 19.5% cases*
      c. *Rifles in 30.0%*
      d. *Other types 0.7 %*

   (2) They also found the favourite suicidal sites:
      a. *Head in 83.7% of cases*
      b. *Chest in 14.0% cases*
      c. *The abdomen in 1.9% cases*

   (3) They found the range of fire:
      a. *Contact wounds in 97.9% cases*
      b. *Intermediate range wounds in 2.0% cases*
      c. *A combination of these or unknown range in the remaining cases*
6. If the shooting incidence was an accident:
   a. The firearm went off accidentally.
   b. The firearm involved was/is defective.
   c. The firearm was mishandled.
   d. The ricocheted bullet hit the victim.
   e. The identity of the target was mistaken.

Why Shooting Accidents?

1. Defective firearms: Safety catch out of order.
2. Light trigger pull.
3. Negligence: Keeping the firearm loaded/cocked at home.
4. Allowing the uninitiated to handle the loaded firearm.
5. Letting the children play with the loaded gun.
6. Firing the bullet at ricochet prone angles/directions; Ricochet bullets have enough remaining velocities to kill/injure persons.
7. Scuffle: Trying to snatch a loaded firearm.
8. Accidental fall of a loaded firearm on hard ground; hammer taking the impact.
9. Kids (under 5) taking a firearm as toy and playing with it, may cause accidents.

1. The statistics relating to firearm does not hold good for India.

10. Youngsters, to show off their prowess, handle guns carelessly and cause accident.
11. In Northern India, drunken people fire guns to celebrate functions (marriage!), and cause accidental deaths.
12. In hunting, hunter often cocks the firearm beforehand, which may get entangled with flora of the jungle and go off, killing/injuring him/other.
13. Cleaning a loaded firearm may cause accident.

7. If the death was homicide or natural death.
8. The *modus operandi* of the incidence.
9. The range and direction of fire.
10. The number of shots fired.
11. The number of firearms/shooters involved.
12. If the subject was dead/stupefied at the time of being shot.
13. If some struggle took place between the assailant and the victim.
14. The weak points in prosecution or the defence cases.

Homicidal Shooting

1. Wounds located at non-suicidal sites, are most likely homicidal.
2. Firing range, beyond powder range is indicative of homicide.
3. Angle of the shot incompatible with self infliction/accident.
4. Multiple shots indicative of homicide.
5. Presence of gunpowder residue on the suspect's hands/clothes/face indicative of homicide.
6. Absence of GSR on the hands of the dead indicate homicide.
7. Shot through clothing indicate murder.
8. Entanglement of the victim in Zun/Zamin/Zar (female/land/property/money/wealth) leads to murder.
9. Revenge lead to murder.
10. Struggle at the scene indicate murder.
11. Vendetta leads to murder.
12. Religious fanaticism is responsible for many murders.
13. Class/faction fights lead to murders.
14. Absence of evidence for suicide/accident indicates homicide.

3. RECONSTRUCTION

3.1 Basics

Any reconstruction of the shooting incident must:—

1. Be based upon legally valid evidence.
2. Be consistent with the ballistics of the firearm/ammunition involved.

3. Be consistent with the scientific, circumstantial, medical evidence and the evidence of the witnesses. Alternatively, it should explain the variance.
4. Explain/link authentic observed facts.
5. Account for the presence of role of the involved exhibits (the firearm, the fired shells or the projectiles, their locations, etc.
6. Establish satisfactorily linkage of the firearm with the injuries/ damage on the victim, the holes/dents at the scene and the fired ammunition.
7. Contain investigator's findings.
8. Agree with the evidence contain in the video tape/photographs of the scene, taken immediately after the shooting.

3.2 The Reconstruction Expert

The reconstruction of a shooting case is invaluable. Correct reconstruction is possible only if the expert:

1. Has ample experience/knowledge of reconstructing shooting cases.
2. Evaluates total evidence which may be at the shooting scene, on the victim and/or with the culprit (firearm, ammunition, GSR on his hands/person/clothes, etc.)
3. Verifies experimentally the peculiar aspects of the case/evidence (defective arm/ammunition, range, spread, etc.)
4. Discusses the evidence with another expert or gets second opinion from another seasoned expert.
5. Illustrates his findings profusely.
6. Quotes from authoritative books to support his conclusions.
7. Discusses/considers alternative reconstruction of the events and gives reasons for invalidity of the alternative mode.
8. Recreates the shooting incident/events through animation.

The reconstruction must account for the total irrefutable evidence from all sources: evidence of witnesses, medical evidence, forensic evidence and circumstantial evidence. The expert explains/accounts for any discrepancies/ incongruencies, if they exist.

4. DATA FOR RECONSTRUCTION

A Forensic Ballistics Expert is the specialist who reconstructs the shooting crime events, in India. The expert studies/examines/carries out the needed experimental verification/evaluates all the available evidence. He consults the concerned specialists whenever needed. He finally prepares a working hypothesis, discusses it with other expert(s) to remove any oddities, incongruencies and then prepares a precise, concise and well-reasoned/illustrated/data-based report. The usual inputs needed for the purpose (reconstruction of a shooting incident) include:

4.1 Visit to the Shooting Scene

The description of the scene is available in the IO's case file/records of the crime scene examination report/court case file. They often contain photographs, illustrations and sketches of the scene. These documents are very helpful. However, they are no substitutes for a visit to shooting scene. The reconstruction expert should visit the scene at the earliest, when the scene is the least disturbed.

Fig. XXI-2

The body of a hunter. He was not 'hunted'! It was revealed by the direction of wound-figure below.

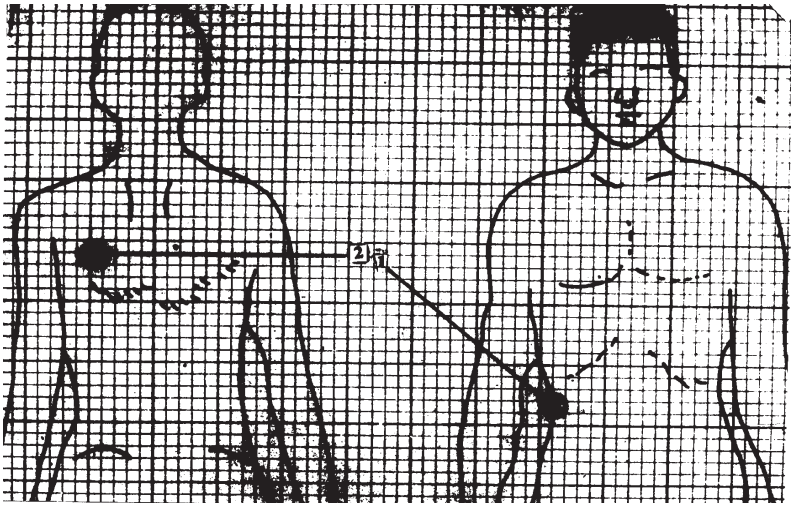

Fig. XXI-3

Was it accident or murder? It had to be decided from the post-mortem report. In the present case there was only one injury - wound of entrance (1). Most of the charge of a 12 bore cartridge was found at position (2), almost under the skin. The angle of fire was almost 75°. Steep upward direction of fire ruled out murder under normal circumstances.

The expert's visit to the scene is highly rewarding. The expert assimilates its layout, the disposition of the corpse, blood pools/spatter, evidentiary clues, the disturbance at the shooting scene, etc. It helps to understand its topography and the inter-distances, the heights, the angles, the obstructions and the like. They all help in the reconstruction. It clarifies the dispositions of the culprit/victim and evidence at the scene. It provides easier/quicker/better appreciation of the IO's textual descriptions/videographs/photographs/sketches, etc. Even a belated visit is useful.

The reconstruction expert should invariably visit the scene in all serious and important cases.

In a shooting case, a boy killed a girl at his residence. The two belonged to different religions. A huge agitated crowd of the public gathered at the scene and shouted slogans. There was a real imminent danger of communal riots.

The preliminary police investigation revealed that it was probably a case of shooting accident. However, immediate proof was needed to convince the public.

The main evidence, which made the public to suspect murder and brought in the crowd, was the firearm evidence:—

1. *The only injury on the deceased was on the face. Its left side did not look like a firearm injury. Instead, it looked as if the face had been brutally battered.*
2. *The medico-legal expert who had been called to the scene, on visual examination opined that it was not a firearm injury and that the girl had been battered brutally.*
3. *The body of the girl was found in a room whereas some projectiles and the marks of projectiles were found in the compound wall, outside the room, at almost 90° to the alleged line of fire.*
4. *There were two close by blood pools at the scene, suggesting struggle*

The author flew to the scene, examined the scene and found the following evidence:—

1. *The head of the girl was X-rayed. The medico-legal Expert attending the case opposed it as unnecessary. The radiogram revealed major part of the charge of a 12 bore cartridge inside the head.*

   The police showed the extracted projectiles to the representatives of the public, to indicate that the girl had died of gunshot injury.
2. *The pattern of blood stains, scattered flesh and bone pieces, location of wads and some fallen pellets revealed the sequence of events so truthfully that the reconstruction could be understood when explained to the representatives of the public.*

The pellet, which had produced marks outside the room had been deflected from the target after striking the bone (probably the jawbone) and had gone out of the window. The telltale marks produced by blood, bone and skin pieces indicated the path of flight and corroborated the 'erratic' flight of the potential troublemaker projectiles. (CH)

4.2 IO's Documentation

Experience and technology has completely overhauled the documentation of the shooting (and other) scenes. A modern IO covers the shooting scene properly.

1. He fixes the geographical position of the scene through GPS software.
2. He walks through the scene to assess its evidential potential and the help (both expert/non-expert) he requires to process the scene. He takes preliminary notes.
3. He gets the total scene videotaped, with close-ups of the important features of the scene. He also correlate the position of the scene with the surroundings (other buildings, other land marks, etc.).
4. He gets recorded the digital images (photographs) of the scene, the surroundings and, more particularly of the evidentiary clues, he finds at the scene. He use high pixel/high quality DSLR camera for the imagery. The main purpose is to fix the location of the various evidentiary items and their inter-spatial relationship. It is useful to understand the pattern of events.
5. Ordinarily the IO draws the preliminary sketch. He makes a rough sketch of the perimeter, fills in the evidence he wants to show in the sketch, records their inter-distances and indicates them on the sketch.
6. It is now common to get an additional sketch drawn to scale by a professional: draftsman/revenue official (Patwari). The IO provides the data (the rough sketch!). Now, more importantly, 2- and 3- dimensional sketches are being created through computers on the basis of collected data. Software for the purpose is available for the purpose.
7. The narrative log is the textual record of the general observations of the scene and The IO records the scene in written form. Now the narration can be oral also. The description is recorded in a CD or a cassette. The second mode has its attractions but it is yet to find currency in India.
8. Video tape of the scene; digital photographs of the scene and the evidence thereon; two sketches, one prepared by the IO; and the second by a professional or a computer created sketch; textual description of the scene and of the evidentiary clues thereon and their interspatial disposition; oddities/idiosyncrasies.
9. Examination of the dead body, if possible.
10. Clothes of the victim.
11. Post-mortem/medico-legal report(s) of the victim and suspect.
12. Photographs of the injuries.
13. Arms and ammunition used in the incident; their basic ballistics.

4.3 Photographs of the Scene

Almost all the scenes of shooting are photographed. The quality and the number of the photographs vary tremendously. Some of the photographs are produced in the courts, others are not. In some cases, no photographs are produced at all.

For reconstruction of the shooting events, the examination of all the photographs, good, bad, 'necessary' or 'unnecessary' photographs is necessary.

They provide the true record of the scene of occurrence when it was least disturbed. The photographs may contain evidence/information, which the IO may have overlooked due to an over-sight or being considered insignificant. It is difficult to fabricate photograph of the scene, though not impossible.

Sometimes the culprit alters the scene before the arrival of the police. He may try to make the homicide look like a suicide or an accident case. The material evidence may later contradict the evidence indicated by the photographs.

A case of alleged 'suicide' was referred to the author. The body of the deceased, as seen in a crime scene photograph, was lying on a bed, with a revolver in her right hand. The victim had allegedly committed suicide after locking herself in the room. The bullet was close to the muzzle of the firearm. There was a rolled up carpet underneath her head.

The resting of the bullets close to the muzzle (after traversing through the head) in the photograph looked rather odd. The author, therefore, visited the shooting scene, which was still preserved after removing the body. A careful examination of the scene and photographs shattered the suicide claim. The evidence, negating it as a suicidal death, was:

a. *The victim did not suffer cadaveric spasm, which could retain the hold of the revolver.*
b. *The revolver used in the suicide, had a live cartridge at 12 o'clock position. There should have been a fired shell.*
c. *There was a bullet dent inside of the rolled carpet.*
d. *There were some washed bloodstains inside the rolled carpet.*

On the material contradiction between the photographs and the material evidence, the impossibility of a suicide was indicated.

A case for murder was registered. (CH)

Fig. XXI-4

The position of the bullet (a) and firearm coupled with the facts that there was a live cartridge at 12 o'clock position in the revolver and the washed blood in the rolled carpet (b) contradicted the claimed version of suicide.

4.4 Clothes of the Victim

The clothes of the victim provide important evidence like projectile holes, projectile wipe, GSR, traces from the surface from where the projectile ricocheted, etc. They help in the reconstruction of a shooting event. They indicate the number of shots which hit the victim), the range of fire, the height of the injuries and possibly the angle and direction of the fire, the nature of the firearm and ammunition. Thus, they facilitate the reconstruction and clarify the occurrence in many situations.

In a hotly contested case, the range of fire was in dispute.

The medico-legal expert had mentioned in the PMR that one set of the injuries, on the shoulder, was skin deep only[1]*. The defence counsel argued that the wounds were caused by a shot fired from a long range. The body was not available, as it had been since cremated. The author therefore, examined the corresponding holes on the shoulder part of the shirt, which the victim was wearing at the time of fire. Nitrite particles were detected on the entrance holes. They indicated a close range shot. The argument of the counsel was, therefore, shown to be incorrect. In fact, it was an angular shot of a shotgun where only a part of the charge had grazed the skin. (CH)*

In another murder case, the prosecution story indicated that the victim was hit by two shots fired by two persons, one from the right side and one from the back. The medico-legal expert who carried out the post-mortem had described three injuries[2] *on the person of the deceased, one on the left side, the other on the right side and the third on the back. He did not identify as to whether the side wounds were entrance or exit wounds. The defence alleged false implication of at least one of the persons.*

The author was asked to examine the total evidence and to indicate if one or more firearms were involved in the shooting.

A thorough appraisal of the post-mortem report did not reveal the number of shots/ firearms, which caused the three injuries on the person of the deceased.

The author examined the clothes worn by the victim at the relevant time. The findings were startling. There was only one projectile hole on the shirt; on is back. It was certainly an entrance wound from close range. There was no other hole on the shirt or on other clothes.

The only possibility was that the three injuries were caused by the same shot: The hole on the back was the entrance hole. The two injuries on the abdomen sides were exit wounds. Parts of shot charge exited from each wound. The shirt was not pierced to create holes because perhaps the ejecta had exhausted most of its energy in creating the wounds.

The court did not accept the prosecution version of two shots. (CH)

1. Three contused wounds, 8 x 6 mm. each on the front of left shoulder. They were muscle deep. There were corresponding entrance and exit holes on the seam joining the arm and the shoulder of the shirt.
2. a. Punctured wound 5 x 2.5 cm. over the front of the abdomen left side. 10 cm above and to the left of the umbilicus, intestine protruding.
   b. Punctured wound, 5 x 2.5 cm over the front of the abdomen; 2.8 cm above and to the right side of umbilicus, intestines protruding.
   c. Punctured wound 15 x 2 cm over the back of abdomen, situated on the spine, 27 cm above the lower end of the spine. An area 3.5 x 4 cm surrounding the wound tattooed.

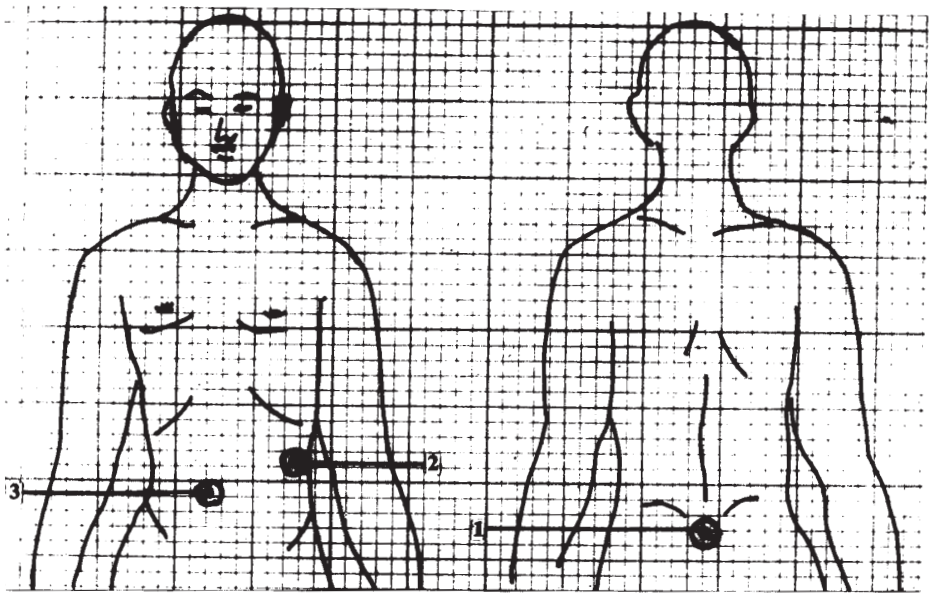

Fig. XXI-5

The absence of holes on clothes corresponding to injuries (2) and (3) eliminated one of the accused who allegedly shot the victim from the right.

4.5 Post-mortem or Medico-legal Report

A post-mortem or medico-legal report is one of the most important items in the reconstruction of crime. It establishes the number of shots, the range, the direction of fire and the nature of arms and ammunition used.

The post-mortem or medico-legal report along with the injury diagram, x-ray radiograph and the materials recovered from the injuries should invariably be examined and studied carefully before the sequence of events is reconstructed. A properly prepared medico-legal report is very valuable.

While passing by the house of a neighbour, a woman - the mother of the three accused and wife of the fourth accused – felt offended when the dog of the neighbour barked at her. A sharp exchange between the women infuriated the men and violent quarrel ensued. One of the accused (A) brought a gun and fired, killing one man (D) and injuring a woman (W) who was standing behind D. The defence admitted the cause of the quarrel. However, they claimed that the other party challenged the accused (A). He accepted the challenge and went into his house to fetch a stick.

At that very moment, he heard his father crying. "I am done to death". He immediately picked up the gun and came back to the scene. He saw the woman (W), his aunt, lying injured nearby. The man (D) was loading a pistol. A fired in self-defence and killed D.

The trial court after evaluation of the evidence produced by both sides, concluded that the version of the prosecution was substantially correct and sentenced A and his father to life-imprisonment. The other two accused were acquitted.

An appeal was filed claiming that the killing was an act of self-defence and not a murder. The ballistics evidence was important in the case and the judges, therefore, thought it fit to refer the case to the author for expert assistance.

The items of evidence were the post-mortem report[1], with injury diagrams of the deceased, the gun, lead shots, and the injury report[2] of the injured woman.

A careful study of the evidence revealed:—

1. *The shots recovered were LG shots.*
2. *The injuries on the deceased were circular and that on the injured irregular.*
3. *The shapes and dimensions of the deceased's wounds and those of the injured woman provided significant help.*

The dimensions were:—

Table XXI-1

Persons	Wound No.	Dimensions of the entrance wound	Dimensions of the exit wound
Deceased	(1)	6 x 8 mm.	12.5 x 12.5 mm.
	(2)	6 x 8 mm	12.5 x 12.5 mm
	(3)	6 x 6 mm	20 x 2.5 mm
	(4)	6 x 6 mm	20 x 12.5 mm
Injured Woman	(1)	5 x 2 mm.	——
	(2)	10 x 10 mm.	——

1. Injuries described on the deceased were:—
   (1) Irregular, lacerated circular wound with edges turned in, 6 x 8 mm., on the left chest 3 cm. below and to the left of the nipple with an exit wound 12.5 x 12.5 mm. on the left back chest wall 9 cm. from the middle line, 8 cm. below the scapula.

   The left 5th inter-costal space had a wound and the 5th and 9th ribs were fractured.

   (2) Irregular circular lacerated wound with the edges turned in, 6 x 8 mm., on the outer side of the left chest wall 10 cm. below the arm pit with an exit wound !2.5 x 12.5 mm. on the left back chest wall 5 cm. from the middle line, 9 cm. below the scapula. The left 7th, 8th and 9th ribs were fractured.

   Pellet fragments were recovered.

   (3) Irregular, lacerated wound with the edges turned in 6 x 8 mm. on the lower part of the left chest, 10 cm. to the left and level with the epigastric region with an exit wound 20 x 2.5 mm. in the left kidney region 6 cm. from the middle line. The 7th left rib (and the inter-costal space) had a lacerated wound.

   (4) A lacerated wound, with the edges turned in 6 x 6 mm. on the left chest wall, 3 cm. below and to the left of injury No. 3 with an exit wound 20 x 12.5 mm in the left kidney region, 8 cm from the middle line.

   (5) Irregular lacerated wound 12.5 x 8 x 5 mm. on the outer side of the left chest wall, 1 cm. from the wound No. 2.

2. The medico-legal report of the injured woman listed the following injuries:—
   (1) One gunshot wound 5 x 2 mm. with irregular edges on the inside of the right thigh (in the lower one-third) 5 cm. above the knee bend. The direction was both inwards and outwards.

   (2) One gunshot wound 10 x 10 mm. on the side of right knee joint 5 cm. above and towards the upper end of the patella bone. The direction was inwards, towards the medial side of the lower thigh.

It was clear from the study:—

a. *The diameters of the entrance wounds on the body of deceased were slightly less than the diameter of an LG shot.*

b. *The dimensions of wound No. 2 on the injured woman were substantially greater than dimensions of an LG shot. An LG shot is the biggest buckshot loaded in shotgun ammunition.*

c. *The dimensions of the woman's first wound were far smaller than the dimensions of any injury on the deceased.*

From the above it was possible to visualise the sequence of events:—

(1) Five buckshots from an LG cartridge hit the deceased.

(2) Four shots caused through and through injuries. The body retained one shot.

(3) During their passage the shots became deformed and flattened.

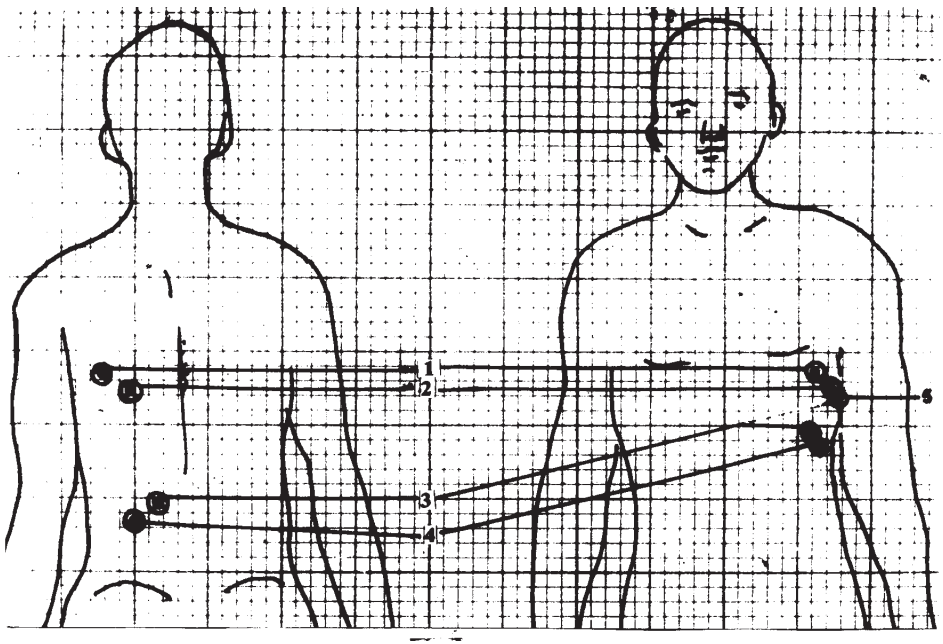

Fig. XXI-6

(1) The position of injuries on the deceased.

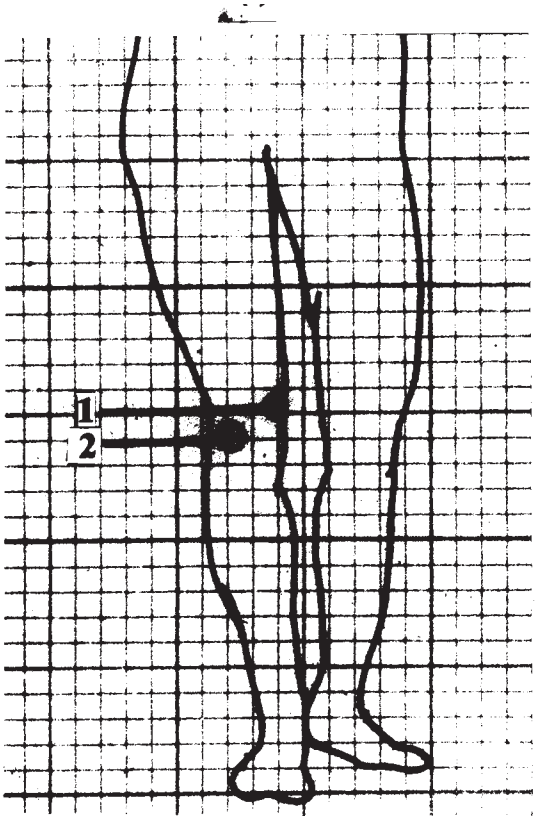

Fig. XXI-7

The self-defence theory was eliminated by a careful study of the injuries of the injured woman. The injuries could be explained best if the projectiles after deformation in the body of deceased hit the injured.

(2) The position of injuries on the injured woman.

(4) When the shots came out, some hit nearby objects and others entered the body of the injured woman. One of the fragments, which re-entered, was much smaller than the other.

The main difficulty in this reconstruction was that the height difference of wounds on the two persons. The injuries on the deceased were at chest level. The injuries on the injured woman were at knee level. There was no evidence to explain the difference. In the absence of evidence, the difference in heights of injuries on the two persons could possibly be due to:—

(1) The injured woman was standing at a higher level than the deceased victim was.

(2) The deceased fell immediately after being hit and the projectile exited when the upper part of the body was near the ground —his chest being at level with the injured woman's knee.

(3) The projectiles were deflected from their path after striking the bones of the deceased.

In fact, some deflections were noticed in wound No. I. From the diagrams, it was observed that the exit wound was at a lower level than the entrance wound. (CH)

In another case of shooting with a stengun, the victim, a military officer, allegedly committed suicide. The military authorities after routine post-mortem examination cremated the body. Later, the members of the family suspected foul play. The case was reopened. The investigations were handed over to the police. The authorities before taking up the investigation wanted to know if the evidence provided pointed towards suicide or homicide. The case was referred to the author for assistance.

The only worthwhile evidence was the post-mortem report. No photographs of the injuries on the deceased had been taken. The clothes of the deceased had been burnt. The tent in which the alleged suicide took place, the firearm and the empty shells did not provide any useful clue.

The post-mortem report indicated eleven entrance wounds on the person of the deceased. The entrance and exit wounds could be grouped into three sets of injuries.

(1) There was a group of five entrance and corresponding five exit wounds. The entrance wounds were on the left side of the chest over the pericardial region. The corresponding exit wounds were on the middle lumbar region on the right side. The direction was downward, the line formed an angle of 45° with the vertical.

(2) The second group, which was of three injuries, was around the front side of the neck. Their exit wounds, which were on the back, were in straight lines parallel to the ground.

(3) The third and the last group of the injuries was roughly in the groin and iliac region. The entrance and the exit wounds formed almost straight lines parallel to the ground.

The possibility of a suicide could be ruled out due to:

(1) the direction of three sets of injuries, almost parallel to the ground

(2) The position of the three sets of wounds. It is not possible to hold the gun to fire the first set (of 5 injuries) downward at that height.

(3) It is difficult to maintain parallel position to cause the second set of 3 injuries. Though the site is reachable to the suicide, yet firing in that position to cause the set of injuries is not possible. And why should the person not fire the shot in upward direction, the convenient direction? A suicide cannot reach/attain the position and direction of the injuries.

(4) The last firing site and the direction of fire is not used by suicide as it difficult to reach and create the firing angle/direction is also a

(5) The last firing site also indicated possible vendetta killing for sex aberrations the victim might have indulged.

(6) A suicide cannot change the direction and the target sites so many times (3 times) after hitting each so many times(5,4,3!!!) at the same site! Any one set of injuries would incapacitate the victim. He cannot create the other two sets of injuries

(7) A suicide has some convenient and favourite site for shooting. The most favoured sites are temple, mouth and underneath chin surface. The victim did not use any of the sites.

A case for murder was registered. (CH)

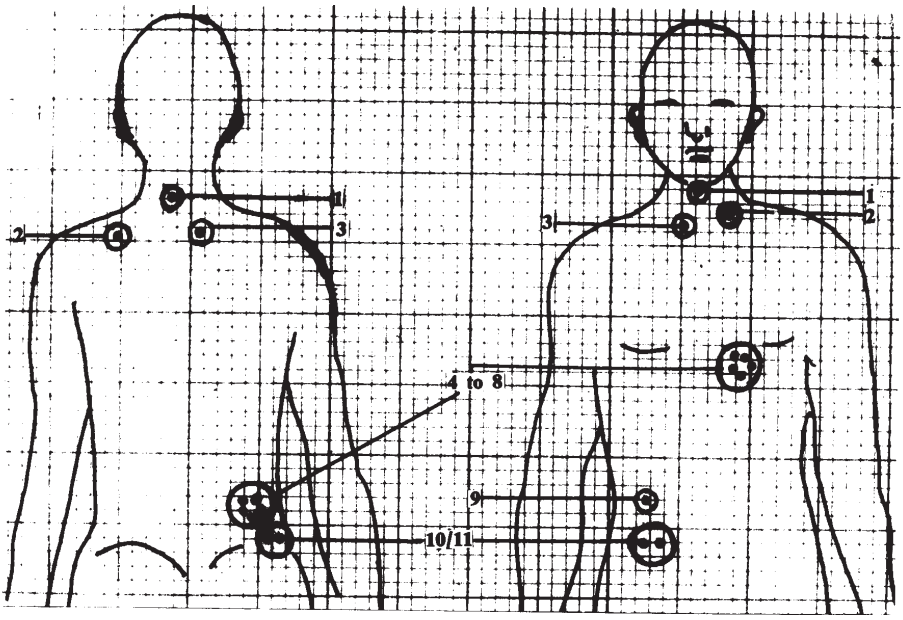

Fig. XXI-8

The three sets of injuries differed drastically in position and direction. A suicide could not have fired conveniently any of the three sets, especially group injuries 4 to 8 and 9 to 11. It was, therefore, considered murder rather than suicide.

4.6 Arms and Ammunition

The examination of arms and ammunition is essential in reconstruction of all shooting cases. It provides the necessary linkage of the incriminating fired ammunition and the firearm. It provides a check whether the thesis advocated by the prosecution or the defence are possible or not. In any accidental killings, where the accident is alleged due to the defect in the firearm, the examination of the firearm becomes indispensable.

In a shooting case, the culprit alleged that in a quarrel, the victim attacked him with a sword. He aimed the gun at the victim to frighten him. The victim instead of running away gave a sword blow to the barrel. The gun went off and killed the victim.

The author was asked to verify the version. He examined the gun and the sword. The gun carried a cut-mark on its barrel. Consequently, the defence version looked sound. The mechanism of the gun was checked, no defect could be discovered.

As a matter of routine, the defence version was enacted. Without loading, a person cocked the gun and held in a firing position. A second person gave a hard sword blow to the gun. The hammer did not fall. The gun could not go off.

The process was repeated about ten times. Each time the hammer did not fall. Instead, the sharp edge of the sword, coming in contact with the gun, folded each time. Further, it did not produce even a semblance of a cut mark on the barrel in all the trials.

The folding of the edge and the non-production of a cut mark completely falsified the defence version. The investigating agency was informed about the impossibility of the defence version.

Further interrogations brought out the truth. The accused had created the cut mark with a Kukri. The IO sent the kukri, which duplicated the original cut on the crime gun. (CH)

In another shooting case, the 'victim' and the 'culprit' were brothers-in-law. One of them had a semi-automatic pistol. They had gone to take bath in a stream. According to the defence version, while the owner was still in the water, the victim came out and started fiddling with the pistol. On seeing this, the owner got worried. He came out running and started snatching the pistol. It went off and killed his brother-in-law.

The police did not place any credence on this story to start with. They apprehended him for murder. The accused continued pestering the authorities that they were harassing him wrongly. At last, the case was referred to the author.

When the firearm was checked, it showed a peculiar characteristic defect. The safety lever of the pistol was in the grip. The person firing the pistol had to press the lever with his palm before pressing the trigger. If the trigger were pressed without pressing the lever, it would not fire. Later, if the lever were pressed, it would fire whether the trigger was pressed again or not.

The accident could be visualised. The victim pressed the trigger without pressing the safety lever. The pistol did not fire. In the struggle to snatch the firearm, the lever was pressed accidentally. It went off and killed the victim. (CH)

4.7 Basic Ballistic Facts

It is essential, in reconstruction work, to know the basic ballistics relating to the arm and the ammunition involved in the case. Thus, one should know the extreme, the killing in addition, the aiming ranges. Similarly, it is essential to know the velocities, the kinetic energy and the behaviour of the projectile at the target, trajectories of the projectile and the wounding powers of the firearm-ammunition combo. For example, if one does not know that a 12-bore shotgun can blow off a part of the body when fired from contact or near contact range, one might mistake the injuries for wounds caused by an explosion. Similarly, the high velocity projectiles cause wounds, which are often so odd as to cast doubt that they are firearm injuries at all.

In a police firing, some persons forming a rear-guard of a protesting crowd of about 15 metres deep were injured though the persons nearest to the police were not injured. The police had fired from a distance of about 15 metres from the front of the crowd. There were buildings on both (right and left) sides. .303 rifles were used for the firing. The victims alleged personal vendetta. The counsel for the police tried to explain the phenomenon by saying that the trajectory of a projectile is curved. Therefore, the person in the back rows of the crowd were injured without injuring persons in front rows of the crowd.

The inquiry officer (a High Court Judge) called the author to elucidate:—

(1) Whether the projectile first goes upward and then goes down to form a curved path.

(2) The relevant heights of the trajectories for the used ammunition and the firearm.

(3) Whether there is any safe zone, where the standing persons would not be injured while those standing behind them would be injured.

The answers to the questions, et erratum were:

1. *The projectile always goes downwards from the line of fire. If it is fired upward, the line of fire will be upward and the projectile will always be below that line of fire.*

   The vertical drop of the projectile from the line of fire after any interval 't' is 'D':

   $$\mathbf{D = \tfrac{1}{2}\, gt^2}$$

   where 'g' is the gravitational acceleration

2. *The highest point in the trajectories would vary with angle of elevation; the heights (vertices) for all practical ranges have been given elsewhere*[1].

3. *If the rifles were aimed at 300 metres, the highest point in the trajectory would be less than 25 cm. It means that the projectile would be dangerous throughout the range. If, however, the rifle was aimed at 1000 metres, the safe zone would be beyond 100 metres (up to 900 metres), when the aim is taken at the chest level.*

The .303 rifle projectiles, therefore, could not hit the crowd on the back at a range of 30 metres without hitting the persons standing 15 metres ahead when the rifles were aimed at all practical ranges. The curved natures of trajectory therefore, cannot explain the injuries under reference.

The falling bullets, if the rifles were fired straight upward could hit and injure persons. However, here also the probabilities of hitting the present crowd were meagre. Observations in the test firing with similar ammunition straight up in the sky indicated that most of the projectiles fell at distances of about 200 metres. The energy of the falling projectiles is sufficient to cause serious or fatal wounds.

The most likely cause of injuries was the bouncing bullets, ricocheted from the walls around, which could injure the persons in the back rows of the crowd without injuring the persons in the front rows. (CH)

1. *See* chapter 4.

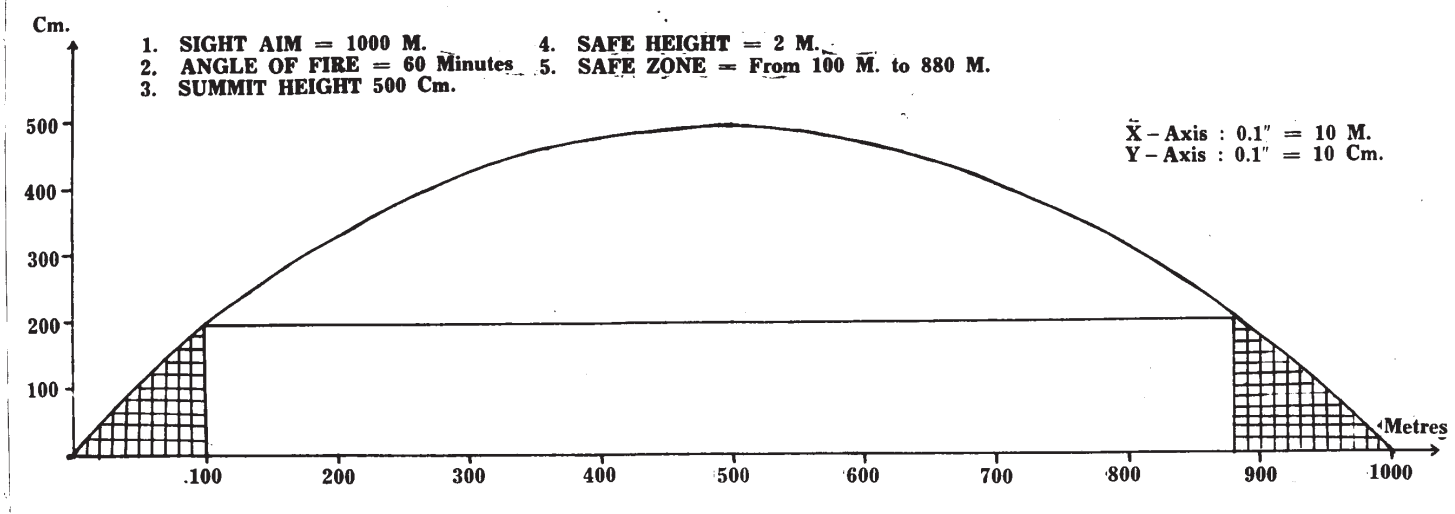

Fig. XXI-9

The diagram (not drawn to scale) illustrates the safety zone and the danger zone.

The velocity of the projectile of standard shape, being 800 metres per second approximately.

4.8 Ricochet Bullets

Ricochet bullets have ample remaining velocity after ricochet, as the energy expended at the ricochet site is small. This is especially true for high velocity bullets. They cause serious injuries, which kill.

Death or injuries by ricochet bullets are not homicidal. Nobody can be sure if the bullet he fired will ricochet at an angle to hit a person intentionally. Sometimes, interesting problems come up:—

The public opposed the recommendations of the Mandal commission, throughout India. The public organised mass agitations. At some places, the crowd became hysteric and violent.

One such place was Mandi town, in Himachal Pradesh. The police tried to persuade the public not to destroy public property; but to no avail. The police had to use force. They first used tear gas but the crowd did not disperse. Finally, they resorted to firing in the air to frighten them. However, one agitator died A bullet had hit him on the back.

It brought in another agitation. They protested against the police brutality, insensitivity and callousness that they have killed the victim while he was running away from the scene. They requested the authorities to take action against the erring police person. An inquiry commission was constituted. The police, however, maintained vehemently that they fired in the air only and did not fire on the retreating agitators.

The commission requisitioned the assistance of the author to find the truth. He:

a. *Visited the scene. The shooting scene was surrounded by hillocks on all side.*
b. *Examined the killer bullet. It was from police ammunition used in .303 rifle, indicating that the bullet had come from the police firing*[1].
c. *The killer bullet was slightly bent. It had some abrasion on the hump part and some small deposit was embedded there.*
d. *Microscopic examination revealed that the foreign material on the bullet was sand grains.*

A clear picture developed from the findings. The killer bullet was a ricochet bullet; ricocheted from a rock. It was elementary to conclude the police did not fire on the retreating crowd. Nor could they control direction of the bullet after ricochet. (CH)

4.9 Demonstration

The firearm evidence is technical. It is not easy for the non-professional to understand it. Besides, if the evidence is left to the verbal or the written description only, it becomes uninteresting and the non-professional loses interest. The demonstration of the evidence, through photographs, illustrations, sketches and actual recreation is, therefore, highly desirable. It should be adopted in all cases, whenever possible. The demonstration can be very simple in some case. In other cases, it can be fairly complex.

1. The .303 arm/ammunition falls under prohibited category.

In an appeal against the conviction, in a case of murder, the defence counsel pointed out that the medical evidence was at variance with the eyewitness accounts. There were three sets of injuries. According to the eyewitness accounts, they all were allegedly caused by the same shot from a 12-bore shotgun. The defence, in cross-examination of the medical witness, made out that there were three shots fired at the victim. The appellate court wanted to ascertain whether the given injuries were caused by one or three shots. Exhaustive experiments were carried out with the suspected firearm and similar ammunition on inanimate models. It was found that the pattern of the injuries could be duplicated from a range of about one to three metres varying the angles of fire. The representative patterns on the models were exhibited in the court. The conviction was maintained. (CH)

In another murder case, there was a rat-hole wound surrounded by small punctured wounds on the person of the deceased. The alleged distance from which the accused had discharged his gun was of about 8 metres.

At the trial, a book on medical jurisprudence was quoted to stress that shots start spreading from about 3 metres. Therefore, the victim, the defence argued, was hit by two shots. Even if one shot was fired by the accused from a distance of 8 metres, it could cause the small individual holes only. It could not have killed the victim was some other person must have fired the second shot from a closer range, less than three metres. It caused the main rat-hole and killed the victim. The accused was therefore, not responsible for the death of the victim. Some other person did the killing.

The argument, at the face of it, looked very plausible. The author created experimental patterns on filter paper sheets using the same firearm and similar cartridge (No. 6 shots). He duplicated the pattern on the body on the filter paper sheet from the alleged distance of 8 metres. The pattern obtained experimentally when exhibited in the court, silenced the defence argument. (CH)

4.10 Court's Participation

In any reconstruction, the court including the defence and the prosecution counsels must be involved. If they do not participate actively and are just idle spectators while the expert is reconstructing the occurrence, they will not be able to follow the reconstruction fully. Besides, if there were some defects in the reconstruction, they would not come to the notice of the court and the counsels. The expert should give the facts, the data, the experiments done, their results and the possible inferences with cogent reasons. The court and the counsels should appraise the same critically, and thoroughly. They should accept the expert conclusions only if they are fully satisfied and convinced. If they are not, they should indicate the reasons for their doubts so that the expert may elucidate his findings further and remove the doubts. If the decision on the case is based only on the arguments on the recorded version or on the forensic skill of the opposing counsels, the cause of justice will suffer where the scientific evidence and the reconstruction are involved.

Some experts (the older generations) feel that their evidence is not only sacred but secret also. They try to give out the minimum amount of information to the court and still less (if at all) to the counsels. There is nothing sacred or

secret about the evidence. It should be explained fully to all the concerned, including the defence counsel and the accused.

4.11 Expert's Performance

An expert reconstructing a shooting incidence is the star performer. He must:

1. Have high order of expertise.
2. Possess both qualitative and quantitative experience.
3. Not vacillate.
4. Be a person of science.
5. Shun conformational syndrome.
6. Create confidence in the mind of the court.
7. Reconstruct shooting incident based on experiments/observations/precedents and their logical inferences/conclusions.
8. Present the reconstruction in simple, precise and concise language; supported with data, reasons and illustrations.

Some experts talk of 'moral conviction' about their findings. They deceive themselves. A 'moral conviction' may be the result of a vivid imagination/a hunch/an intuition. The expert must talk of factual evidence, experiments, observations, data and inferences only. If he sticks to them, nobody can attribute the stigma of incompetence, bias or dishonesty to him. The opinions and the reports based upon 'moral convictions' have no place in scientific evidence.

Some experts ridicule the versions or hypotheses given by others, especially by the non-specialists. This is undesirable. They must point out the lacunae/incongruencies/incompatibilities of such versions; but they must do so politely and persuasively. The Judge or the counsels are not Forensic Ballistics experts. Their expertise lies elsewhere. They are, therefore, likely to make mistakes. There is nothing derogatory about it. If they were able to do the job themselves, then the experts become superfluous.

If one performs his duty without fear or favour and efficiently, he wins the confidence not only of the court but also of the defence. The following elements help:—

1. The expert should not interest himself with the involved personalities—the accused or the victim. The familiarity with one party induces fear of bias in the minds of the second party.
2. The expert should not hesitate to answer the questions correctly and completely even if the answers go against the main thesis.
3. It is difficult to answer the questions off-hand and at once, in expert evaluations. There is, therefore, some hesitation on the part of the expert when he answers questions. An honest expert should not fear that his hesitation would be misunderstood. In fact, an expert who propounds the theories and answers the questions after taking some time to evaluate the facts is considered a conscientious worker. A

person who is quick with his answers is either dogmatic, ignorant or dishonest. For the reconstruction of a shooting event the expert should take sufficient time to:—

a. Read the relevant record, evaluate the available evidence and to ascertain *inter se* consistency.
b. Study relevant literature for supporting his thesis and to quote appropriate authorities.
c. Discuss the subject and his experiments/findings with his superiors/colleagues/subordinates.
d. Perform experiments and to observe and compare the results and the inferences.

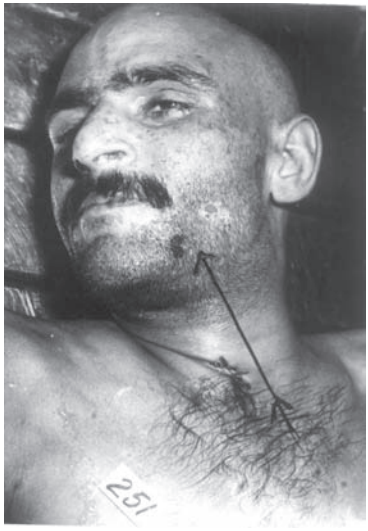

Fig. XXI-10

Direction of wound (chest, chin) confirmed suicide.

4. The expert should not hesitate to admit his ignorance if he does not know the answer to a particular question. He should not hazard a guess/opinion, when he is not sure.
5. The courts often put up problems of reconstruction when the expert is giving the evidence about the routine matters, like the identification of the cartridge cases/bullets, for which he has already performed experiments in his laboratory. The courts sometimes want the solution immediately. It is neither possible nor desirable. The expert is likely to make mistake in haste.
6. The courtroom atmosphere is not conducive for a correct scientific evaluation. It is, therefore, essential that the expert should take sufficient time to carry out the necessary experiments, to make proper observations and to hammer the inferences to a logical single conclusion, consistent with the other known facts and evidence.

4.12 Crime Scene Reconstruction and Presentation

A revolution is in the offing in the presentation of the crime scene in courts: of the evidence and of the occurrence thereon, thanks to the advent of videography, computer technology and animation to produce virtual reality of the occurrence. The following modes are used:

1. **Videography**

   Videograghy is being used to record the shooting scene increasingly. The presentation of the recording brings the scene in original state to the courtroom. The tape enables the court to understand/appreciate/appraise the scene as if the court is visiting the scene at site. It provides the court an unbiased view of the scene, which is, otherwise, often impossible to achieve, as the cases come up in the courts after long intervals of time.

2. **Computer Graphics**

   The use of computer graphics in the presentation of crime scene evidence can be understood by a simple real-life example:

   In a case of dacoity, the police version of an encounter was hotly contested. It was alleged that there was no encounter. The victims were picked up and killed in cold blood.

   One of the arguments given for the no-encounter version was that in spite of hundreds of shots fired, from both sides, no police officer was seriously injured, when the police was firing from allegedly three directions, in pitch dark. Cross firing by the police and the dacoits should have injured them.

   The author studied the case closely.

   The shooting scene was a lonely animal house where the dacoits have gathered and planned the strike. The police, on getting the information, had surrounded the house covertly and deployed the force in such a way that while their firing would cover all the possible exit routes from the three positions taken, the cross-firing would not hit the police parties deployed at the strategic positions.

   The encounter took place at the dead of night, in pitch dark. The police parties knew the position of the dacoits and their possible escape route(s). They covered the hideout so well that few dacoits could escape. On the other hand, the dacoits did not know the position (or the strength of the police force) nor could they see police officers in the dark. Hence, no serious injuries to the police personnel! The graphic presentation made the matter easy to understand. (CH)

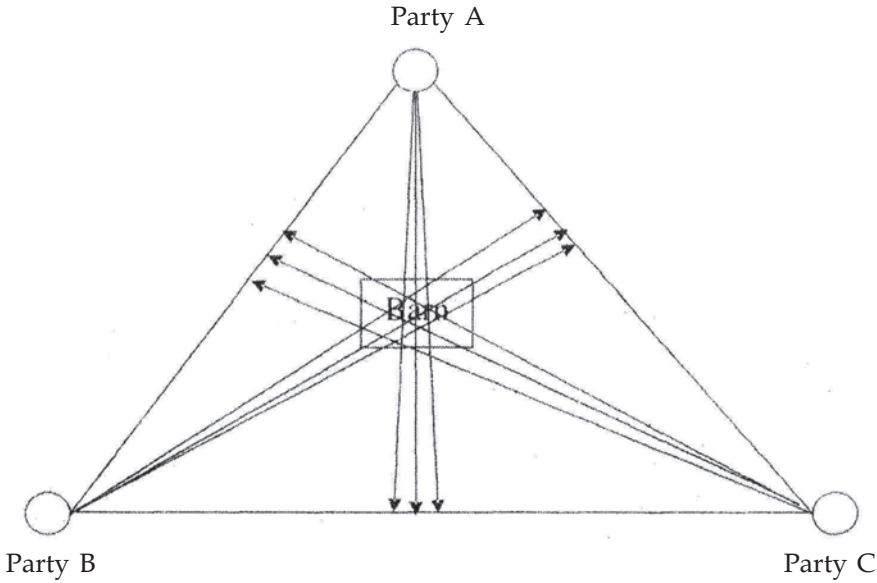

Fig. XXI-11

Police Deployment (Schematic)
(No line of fire crosses the Police Positions: ABC)

The author has also used computer graphics with dramatic results to illustrate/indicate the path of the projectiles and their directions, in shooting cases; to reconstruct sequence of events and to verify versions or to give the correct version of the occurrence.

5. SOME NOVEL SHOOTING RECONSTRUCTIONS

5.1 Gang War

In an interesting case of gang war, the leader of one gang was killed. The eyewitnesses, members of his gang, alleged that they were attacked while they were running away from the killer gang. They had no firearms and did not give any fight. However, recoil injuries on the person of the deceased on the left hand, proved that he had fired a firearm with his left hand: the deceased carried evidence that he had given a gun-fight:

1. *There was blackening and tattooing on hypothenar and thenar region. The presence of blackening and tattooing indicated, beyond reasonable doubt, that he had fired a firearm with his left hand, which caused the blackening and tattooing at the sites, which is apparently from the smoke which comes from the chamber end.*
2. *There were injuries on his left hand (on hypothenar region/distal phalange of the little finger/thenar eminence). They were lacerated wounds only and were not caused by projectile(s). The presence of GSR further fortified the thesis that these injuries were caused because the victim held the firearm loosely.*

Fig. XXI-12

The lacerated region coloured (schematic)

3. *The position of the handgun held in the left hand is illustrated in the figures below. The arrowheads indicate the sites of contact on the left hand and they will be the sites of injuries, due to recoil, when a firearm is held loosely. The deceased victim must have fired the firearm holding the same loosely. Recoil of the firearm lacerated the sites to cause the injuries.*

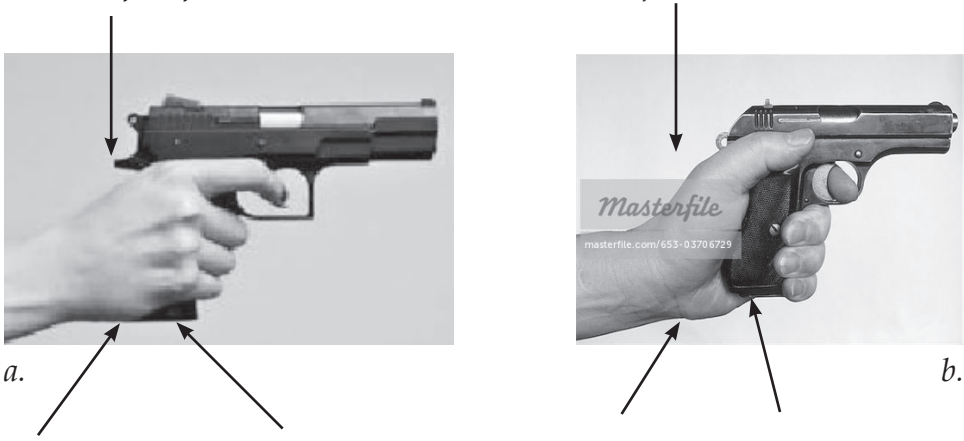

Fig. XXI-13

The holding of the firearm to cause the given recoil injuries:

a. Exterior view of hand and the affected parts b. Medial view of the hand

4. *The injuries were not projectiles injuries, because:*
   a. *Injuries were close to each other. No shooter, under the circumstance of the case, could achieve so close a group of injuries, even if he wanted to.*

b. *There were no punctured/tear wound(s) which were inevitable if they were caused by projectiles.*

c. *Injury sites corresponded to the contact sites when a handgun was held and fired.*

d. *The force of recoil is equal and opposite to the force with which the projectiles(s) goes forward (**To every action there is equal and opposite reaction).** This force moved the firearm violently and injures the hand.*

e. *The severity of injuries depends upon the recoil force and the looseness with which the firearm is held.*

*In short, injuries on the left hand of the deceased were recoil the handgun was held loosely at the time of firing**. (CH)***

5.2 Onus of murder

It is an unusual case of murder. The culprit showed extreme cunning. He tried to pass on the onus of murder to the police.

A. The brief facts of the case:

1. *The police (one inspector and 2 constables), in a police Jeep, were allegedly searching for reported criminals moving in the area in a vehicle. They found a Maruti car, parked in a field on a kucha roadside, under suspicious circumstances.*
2. *A person, Mohan was sitting on the driver seat. On seeing the coming police vehicle, he tried to drive away. However, the car got stuck in the mud after traversing a short distance (~20 m).*
3. *The police allegedly thought it to be the vehicle carrying the reported dangerous criminals under suspicious circumstances; running away when challenged. They fired upon the vehicle before overpowering Mohan. The police put him in the Jeep and took him to the police station.*
4. *The police searched the Maruti car and found one dead female (Suman) on the front passenger seat of the car.*
5. *The police seized the car and took it to the police station.*

Soon the rumour spread that the police killed a woman in police firing. A case of culpable homicide was registered against the inspector and the two constables. They were arrested and after investigation, case was put up for trial.

At the trial stage, the accused approached the author to appraise the evidence to find out if Suman died of police firing or otherwise.

B. Forensic Experts' findings

The experts from a central laboratory and the state laboratory examined the car.

They discovered that at least four shots had hit the vehicle as there were four clear entry holes (ascertained by the inward inversion of the plastic film and inward depression of the metal at the impact site) on the vehicle:

1. ***One entry hole** (size: 2 x 1.5 cm) was on the boot, fired from behind. A .38 bullet was found stuck in the metal sheets of the dicky cover. The direction of the fire was indicated by the inward dent of the hole at the site.*

2. ***Second entry hole*** *(size: 3 x 1.5 cm) was on the hind windscreen. The shot had pierced the screen and created the hole. The direction of the shot was indicated by the inward inversion of the edges of the film. The direction was from the backside to front side of the vehicle.*
3. ***Third entry hole*** *(size: 0.9 x 0.9 cm) was on the metallic part of the right side of the vehicle. It was formed by a gunshot, fired from the right-back side. The direction of the fire was clear from the inward depression of the metal sheet at the dent site.*
4. ***Fourth hole*** *(size: 3.5 x 2.0 cm) was in the hind triangular fixed windowpane on the right side. A gunshot fire created it. The inward insertion of the film edges indicated that the shot was fired from the right-back side.*
5. *The experts found that* ***"the fire on the vehicle was from the back and right-back sides of the vehicle".***
6. *The experts also found three exit holes on the front windscreen. They accounted for the exit of all the remaining three bullet entering the car. The fourth shot bullet was recovered from the boot of the car.*
7. *The experts did not find projectile marks on left side of the car and categorically stated:*

   "Left side: No entry/exit hole on the left side of the car could be detected."
8. *The expert did not find any broken window panes/bullet holes or dents on the left side of the vehicle.*

C. Closed Window

The only plausible 'witness', Mohan had stated that the windows of the car were closed. It is natural also to close the windowpanes in such severe cold winter days. The police also found the all car window panes closed.

D. Appraisal

The above observations, about the number of shots, direction of fire, the condition of the car at the material time, are highly significant:

1. *They prove that there was no firing from the left or front side of the vehicle.*
2. *They provide clinching evidence that the alleged police firing did not kill Suman.*

Reasons*:*

a. *In the police firing, four shots were fired. Their entry/exit holes had been identified. All the entry holes were on the back or right side. None was on the left side. All the exit holes are on the front side. They, thereby, establish the trajectories (the lines of fire) of the shots. These Trajectories nowhere touched/crossed the body of Suman because there were no entry wound on the back or right side of the victim corresponding to these trajectories. Naturally, alleged police firing did not kill Suman.*

b. *The only shot, which injured/killed her was on the left side of the neck; fired at right angle (~90^0) to the trajectories of the police bullets.*

c. *The killer shot on the person of the victim has entered the left neck and exited from the right neck, almost in a straight line (slightly upward, according to the PMR/ doctor in his statement in the court). This approximate right-angled direction of the killer shot is completely incompatible with the police bullets trajectories.*

d. *The police firing could not inflict the injuries on the victim, in the alleged sitting position on the front passenger seat because the injury trajectory,* ***left → right*** *is incompatible with all police bullet trajectories which are from* ***back → front.***

It can be said, ***beyond reasonable doubt****, that the police-fired shots did not kill Suman.*

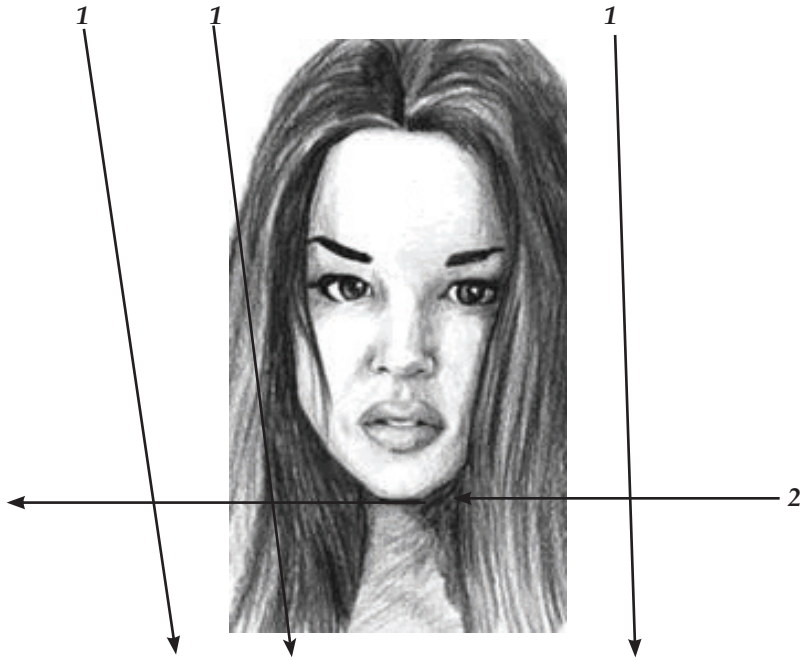

Fig. XXI-14

1. Schematic police bullets trajectories(1)
2. Horizontal arrows show killer bullet trajectory
(RHS ← LHS)

E. Other Evidence

The other evidence, which show that police firing did not kill the victim:

a. *No entry hole, dents or scrapes of projectiles on the left-hand side of the car*
b. *No blood around the dead body*
c. *No killer bullet found in the car,*
d. *No exit hole on the right side of the car, to indicate its exit; closed windowpanes were intact!*
e. *No corresponding injury to Mohan from the exiting projectile*
f. *There were drag marks on the upper and backside of the right arm. Probably she was dragged to and placed in the car after killing her outside.*

g. There was only one fellow of the chapel on the feet of Suman. The other was not even in the car. It probably dislodged in the dragging, while shifting the body to the car. It indicates that the killing was outside the car.

In all likelihood, the killer shot Suman in the open and the killer projectile flew away in the open space. Her dead body was placed in the car!

6. ADVANCING FRONTS IN SHOOTING RECONSTRUCTION

Gadgets have come up which are facilitating the reconstruction of shooting incidents. Some of the helpful technologies are:

6.1 Virtual Reality Animation

Recreation of incidents through animation creates virtual reality. The process recreates the occurrence. It is a potent presentation mode of the occurrence. It can be an extremely effective method to convince the courts. However, there is danger of its misuse also. The facts of the case have to be right and used without bias. The presentation of crime scene through animation to produce virtual reality has already started in some countries. It is high time we start using the same in all-important cases.

Computer-generated three-dimensional (3D) animation seems to be an ideal mode to visualize shooting (and other crime) scenes accurately to all concerned. It is based upon factual data. It can recreate the scene and depict the activity at various individuals

The use of animation techniques to reconstruct crime scenes is being adopted in some countries. India will take some time to induct the technology. It is likely to replace the traditional modes (illustrations/photographs/verbal descriptions).

6.2 Computers in Sketching Shooting Scene

Recent advances in electronics have further simplified the sketching process. Computers and special software are being utilised increasingly to get the final sketch. Many a software has come up in the market, which have improved the quality and the accuracy of the sketches/maps tremendously. They have also reduced the time for their preparation and drudgery. Software has also come up which can introduce image of the object in the outline of the sketch.

The mapping experts work on the data provided by the investigating officer. The rough sketch, with mapping details (measurements), proves handy. However, the investigating officer must provide the necessary details; critically appraise the details of the drawing so that it is correct, complete and comprehensive. It is better if the map specialist is provided with the inspection report, video-film and photographs of the scene. They give complete overall picture of the scene to him, which helps in producing a better sketch.

6.3 Global Positioning System (GPS)

GSP is a radio navigation system. It allows users to determine their exact location 24 hours a day in all weather, anywhere in the world. It is being harnessed, as a forensic tool, for use in shooting incident reconstructions and the creation of presentations of related shooting scene evidence.

This software is user friendly, can be readily utilized by the expert reconstructing a shooting incident ant its presentations in the court.

6.4 Computer-Aided Design (CAD) Software

CAD is the use of computer technology for design and design documentation. Architecture and structural engineer use it. It has replaced manual drafting with an automated process.

The software is now being adapted to shooting (and other crime) scene mapping and sketching software. Architects are using the software in their work routinely. It should not be difficult to adept it to forensics. The software can help to delineate trajectory of the projectiles in shooting incidents.

6.5 Flight Path Bracket (Trajectory Determiner)

A rod like gadget, called Flight Path Bracket, has come up. It is proving useful to delineate trajectories accurately, in shooting incidents from projectile holes/injuries. It is likely to be used increasingly in future.

The gadget secures placement of a flight path rod to measure and gather data related to a bullet hole/injury. It provides measurements and a visual illustration of the hole/injury to others.

6.6 Geospatial Technology

Geospatial technology software has a number of applications in law enforcement. The software was created for defence forces. However, it has potential for use in shooting incident reconstructions and their presentations. An expert reconstructing the shooting incident can use the software without tears. It involves the following tools:

1. Specialized Storyboards

The storyboards is useful to demonstrate the size of the scene, the movement of the individuals at the time of the shooting, crime scene photographs, video footage and any other relevant material in a single presentation.

The storyboard can serve to demonstrate the placement and movement of the suspect during the shooting. It also shows the locations of victims, vehicles, buildings and miscellaneous pieces of evidence.

The storyboard helps to present the evidence of a shooting incident (or other crime) in a court, more effectively, convincingly and without hazard of confusion.

2. Global Imagery

Geospatial technology software utilizes pre-existing digital imagery from numerous sources (GIS data, GPS, etc.).

3. Metadata and Media Source

Metadata is the information contained within each pixel of the image that allows it to be geospatially referenced in software. Metadata has been exploited in forensics to place a shooting incidence images accurately within a satellite image of the area of the scene.

Special software allows accurate measurements of anything within a complex shooting scene.

FORENSIC BALLISTICS IN COURTS

SYNOPSIS

1. GENERAL

2. THE EXPERT

2.1 Qualifications

2.2 Basic Steps

3. REPORT

3.1 The Proforma

3.2 Conclusive/Inconclusive Reports

3.3 Conclusions

3.4 Illustrations

3.5 Language

4. PRESENTING COUNSEL

4.1 Brings *Bona Fide* of the Expert on Record

4.2 Ensures that Testimony is Demonstrative

4.3 Anticipates the Defence Stand

4.4 Is Aware of the Diminished Value of an Inconclusive Report

4.5 Is Attentive during Cross-examination

5. DEFENCE COUNSEL

5.1 He Assimilates/Understands the Evidence

5.2 Anticipates the Expert Evidence

5.3 Plans his Cross-examination Carefully

5.4 Checks *Bona Fide* of Expert

5.5 Evaluation of the Evidence

5.6 Fundamental Explorations

6. THE COURT

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7. FALLACIES ABOUT EXPERT EVIDENCE

7.1 'Court must form its Own Opinion'

7.2 Eyewitness Bias

7.3 'The expert must conform to "yes" or "no" technique'

7.4 'The expert must answer all questions'

7.5 'Expert testimony is weak evidence'

7.6 Proof beyond 'Reasonable Doubt'

7.7 'Expert usurps court's functions'

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FORENSIC BALLISTICS IN COURTS

> ***"It is difficult to see how any reliance can be placed on the opinion unless it is supported by good reasons founded on the facts that warranted that opinion. If the reasons are good and convincing, and the factual data on the basis of which the opinion is formed, warrant the opinion, the court will rely on the opinion."***
>
> **Justice Bhagwati in *Suleman Usman Memon* v. *The State of Gujarat,* AIR 1961 Guj 120: 1961 Cr LJ 7**

1. GENERAL

Acceptability of Forensic Ballistics Evidence

1. Legally admissible U/s 45 of Indian Evidence Act, 1872.
2. Tried/used for about a century. Never failed.
3. Verified/verifiable/review by peers/published.
4. Accepted by the Forensic Fraternity.
5. Uniqueness of thumbprint of a gun well-established.
6. Sound: theoretically/experimentally.
7. Practised and utilised all over the world.
8. Universal Acceptance.
9. SC acceptance in numerous cases.

The evidence relating to firearms (forensic ballistics) is technical in nature. The *Indian Evidence Act, 1872*[1] and the *Criminal Procedure Code, 1973 (CrPC)*[2] cover the legal aspects of the expert evidence. The expert examines the clues in his laboratory. He may also visit the shooting scene to secure first hand information of the scene. He performs the necessary experiments, makes necessary observations, collects data and draws conclusions. He presents the evidence to the court along with such data, illustrations, charts and photographs, which make the findings intelligible and convincing to the court. He presents the finding in a written report or orally in the court personally. In both cases, the presentation furnishes adequate, concise/precise supporting data for the findings in simple, nontechnical language.

1. Section 45 of the *Indian Evidence Act*, 1872.
2. Section 293 of the *Criminal Procedure Code*, 1973.

Section 293 of Cr P C (applicable with effect from April 1, 1974) allows the acceptance of reports of certain government officers, without personal attendance. It includes the director and deputy/assistant directors of a Forensic Science Laboratory. The courts accept the written report alone. However, they can, if they deem fit, order the expert for personal attendance to explain/elaborate the evidence.

The prosecution counsel assists the expert in his presentation. The defence counsel appraises the expert and his evidence critically. The conscientious judge carefully observes the performance of the expert/presenting counsel/defending counsel and assesses the relevance/quality/adequacy of the data evidence. If there are lacunae/ambiguities/inadequacies in the evidence, he intervenes and gets them cleared. He, ultimately, makes the final assessment to use/discard the evidence in the dissemination of justice.

There is no material difference in these aspects whether the expert is being produced as a prosecution/court/defence witness. The judge is the ultimate authority to accept the expert's *bona fide* and the *locus standi* of his evidence.

2. THE EXPERT

I am Forensic Ballistics Expert!

1. Academically, I am M Sc (Hons)/Ph. D in Chemistry.
2. I had training in New Scotland/other Home Office Laboratories, in Forensics in UK for 4 months.
3. I have handled thousands of Forensic Ballistics cases, over the past few decades and gave evidence in courts.
4. I have written/published about a hundred papers in Forensics including some on Forensic Ballistics.
5. I have written/published over half a dozen books on Forensics, including one on Forensic Ballistics (Fifth Ed.).
6. I have been teaching Forensics to one and all: Forensic science students/medico-legal experts/judges/lawyers/investigators and others.
7. I have participated in examinations/reconstructions of shooting scene/cases.
8. I have participated in forensics conferences/meetings/seminars/workshops.

The Ballistics expert is the chief player in the presentation of expert evidence to the court. He is a man of science and bases his findings on observations/experiments/Study/evaluation and the logical inferences drawn from the generated data, without bias/interest in the parties.

The presenting counsel regulates the presentation; the defence counsel is on the lookout for lacunae and the judge ensures orderly and legally correct presentation of the total evidence. In short, active participation of all involved persons of the court facilitates effective and rewarding presentation...

A lot depends upon the proper performance of the expert. He has to bring the technical evidence to the level of an educated nonprofessional. He eliminates the technical words and intricate theories.

The efficient expert presents the evidence in the court after:

a. He has discussed the evidence with other departmental experts.
b. The expert gives a copy of the report to the counsel in advance in advance holds a brief pretrial conference to delineate the course for effective presentation.

2.1 Qualifications

An expert appearing in the court is 'qualified' to start with. The elements of his qualifications are brought on record:

1. Academic accomplishment.
2. Training: what/when/where/how long.
3. Experience, both in firearm case examination and in related fields.
4. Research work: topic/duration.
5. Participation in seminars/scientific meetings/symposia/workshops.
6. His publications: books and papers published.
7. Participation in seminars/conferences/scientific meetings are noted.
8. Participation in workshops.

The data recorded shows that by education, training and experience the person is qualified/not qualified to give expert evidence on the subject.

The court scrutinizes the record and his performance in the court and decides whether the person giving evidence is a qualified expert or not. If the qualifications are scrutinised carefully, it is possible to eliminate the impostors at an early stage.

Specific experience in the expertise is important. If a man has handled hundreds or thousands of firearms for a number of years as a hunter, a gun collector, a gun dealer or even as a gun maker, the experience does not make him a ballistics expert, just as a bank clerk does not become a document expert. If a man has some basic scientific knowledge, training in microscopy and photography and some knowledge of firearm ballistics, he would definitely be a better expert even if he has handled only a few firearm cases. The 'gun cranks' cannot be modern forensic ballistics experts. However, if a 'gun crank' starts practicing the expertise, after proper training and study, he can be a real boon to the profession.

Quantitative experience added to the qualitative experience, is prized. This is achieved in the professional forensic science laboratories, where the ballistics experts examine firearms only. Here, the expert achieves a high degree of specialisation. The dedicated experts know the latest developments and contribute to the progress.

The greatest menace in expert testimony is the corrupt expert. He, for money, gives tailor-made opinions! His practices are varied, and he may:

a. tamper with the crime or test exhibits,
b. suppress the main points of evidence and lays stress on the minor points of differences,
c. scuttle complete tests and examination,
d. produce no test exhibits,
e. produce distorted/wrong illustrations.

It is often difficult for the lawyers and the judges to detect these frauds. However, the corrupt experts achieve notoriety, which spread among the lawyers and they know the corrupt expert. The judges also come to know these corrupt experts through them. Besides, some judges peep deep into the evidence and find its fraudulent nature. They expose his corrupt character in their judgments and pass strictures, making the corrupt known. The courts, thereafter, accept the evidence of such entities with caution.

The specialists from the universities and other institutes of higher learning sometimes give evidence. They have limited court experience as experts. They find it difficult to express themselves in non-professional language. However, they, on asking, explain/elucidate the evidence logically and intelligibly.

2.2 Basic Steps

The expert, before tendering evidence in court, does his homework meticulously and ensures that:—

1. He is thorough in his examination, has prepared notes and illustrations, consulted literature, quoted authorities and appraised the evidence/data/findings with subordinates/colleagues/superiors before submission of the evidence in the court.
2. He evaluates the negative (contradictory, non-supporting) evidence and taken notes and reasons to discard/ignore the non-supporting evidence.
3. He does not allow his imagination to go beyond the realm of observed facts, does not hasten with his opinion on incomplete data, has no bias/dishonest intentions.
4. He does not propound/maintain complicated and unintelligible theories dogmatically.
5. He is not swayed by conformational syndrome.
6. He does not use high-sounding words and jargons.
7. He takes sufficient time to study/examine/evaluate all relevant factors and harness available sources of information to provide answer to the problem put to him.
8. He has weighed both positive/negative evidence and his conclusions are based on the preponderance of the evidence.
9. He knows the current standards of proof *vis-à-vis* the expertise and considers them before giving his findings.
10. He does not lose temper, keeps his cool when the defending counsel provokes him to rattle his focus.

11. His conclusions are clear, unambiguous, definite and brief. He knows their degree of accuracy/probability. They lead to only one conclusion, his conclusion.
12. He is conversant with the latest developments in the field of his expertise.
13. He is a man of science and his findings emerge from, experience, correct observations and experiments and not from his hunches/ intuitions/'expert eye'.
14. He has no friends to save or enemies to punish.
15. He gives reasons, which are on accepted principles and laws of Forensics Ballistics. Law[1] permits the expert to furnish reasons.
16. He does not bluff. If he does not know the answer to a question, he confesses ignorance.
17. He does not act as an 'instantaneous' expert, takes time to consider any question put to him and weighs his answer before he utters the same. He gives reasons for the answers.

Active participation of the court, including concerned lawyers, facilitates proper presentation. Seeking clarifications and elucidations brings out the best in the evidence and removes the ambiguities.

3. REPORT

Hallmarks of a Good Report

1. It is Concise, Precise yet Comprehensive/Intelligible/ Convincing.
2. It is in Simple Intelligible Language. No Jargons/Unexplained Technical Terms/Formulae/Ambiguous Theories
3. It has Preponderance of Supporting Data for its Conclusions.
4. It Explains the Contradictory/Non-supporting Evidence (data).
5. It has Quality Illustrations to Support the Report.
6. It is Well-reasoned and Permit only the given Interpretation.
7. It is Self-contained, Self-explanatory, Self-testifying.

3.1 The Proforma

Firearm experts, all over the world, have standardized the report proforma. They may vary somewhat in minor details of the format, yet, essentially, they are alike. The included details are:—

1. Expert's brief bio-data, showing him as expert.
2. The laboratory case and report numbers.
3. The case: FIR No. name of police station/district, date of the FIR, etc.
4. The referring authority.

1. Section 51 of the Evidence Act: "Whenever the opinion of any living person is relevant, the grounds on which such opinion is based are also relevant".

5. Reference letter number with date.
6. The mode of the receipt; name of the messenger.
7. The date of receipt of the letter/exhibits.
8. The description of the packages (with their contents): their number, identification marks, seals, their condition and the signatures thereon.

Fig. XXII-1

The investigating officer wanted to be doubly sure of the identity of the exhibit. He puts a currency note as an identification chit. The number on the note helped additionally to establish the authenticity of the exhibit.

9. The description of the exhibits, identification marks, signatures or the initials, etc.

   The Rajasthan High Court[1] has condemned negligence in this regard:

   Another point that has been urged is that though it is proved that these articles were recovered from the possession of the accused, and they are the articles which are before the court, there is no proof that these were those very particular articles which were sent to the chemical examiner for examination.

10. The Questionnaire (in brief).
11. The dates on which the examination is commenced and completed.
12. The number and nature of the test exhibits prepared.
13. The experiments carried out, the observations made and the conclusion drawn.
14. The name of the examiner, his designation and his qualifications.
15. The mode of the despatch of the report and the exhibits.

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1. *State of Rajasthan* v. *Motia*, AIR 1955 Raj 82.

The description has necessarily to be concise but sufficient to prove the conclusions arrived at convincingly. The reports are, now, admissible as evidence under section 293 of the Cr P C. The non-expert professionals appraise the evidence in most of the cases, without the assistance of the experts. It is therefore, imperative that the reports are in simple non-technical language, well reasoned and illustrated to make them convincing.

3.2 Conclusive/Inconclusive Reports

The reports are classified according to the findings of the expert. Thus, we have:—

a. Definite positive/negative reports,

b. Indefinite reports: with high/low probabilities, or

c. No conclusions: insufficient/confusing evidence.

A conscientious expert gives a definite report on linkage/de-linkage of arms and fired ammunition only when he has founds evidence, which is at par or above the standards established by the forensics fraternity.

All identifications including Forensics Ballistics identifications are based upon probabilities. Many including the court do not know this basic tenet of identification. They are prone to ignore reports if probability is brought in. A decision of Calcutta High Court[1] is relevant on the point:—

> *"Upon an analysis of the said evidence we agree with the defence counsel. It is passing strange that an expert in his ultimate opinion would depend upon probabilities and not on the firm conviction, in the absence whereof, the said evidence becomes dangerously thin indeed and the court of law would not take that by itself into consideration for the purpose of fixing the guilt of the accused. The expert having reached the point of interrogation or of probability cannot be relied upon for the purpose of conviction in a case under section 302, IPC."*

It should not be so. The value of the probable should be considered/utilised.

The weightage given to an inconclusive report varies from one report to another. One report may be inconclusive only technically. In another case, the evidence may be perfunctory and the value of the report hardly crosses the realm of possibility. Between the two extremes, the probabilities vary. The court should ascertain the value of an inconclusive report from the expert and give corresponding weightage to an inconclusive report.

In firearm identification, the expert usually furnishes definite reports; indefinite reports are rare.

The expert should send the reports, immediately. However, most of the experts, unfortunately, fail to do so. The adage **'justice delayed justice denied'** is literally true in some cases. The Patna High Court[2] has deplored the delay:—

> *"This inordinate delay in the examination by the ballistic expert is to be deplored. It is unfortunate that in such serious cases, the expert does not attach sufficient importance for a speedy examination and submission of his report."*

1. *Bhullaram Koiri* v. *State of West Bengal*, 1970 Cr LJ 403 (Cal).
2. *State of Bihar* v. *Hanuman Koeri*, 1971 Cr LJ 187 (Pat).

3.3 Conclusions

The expert should use standard wording for conclusions. It will increases clarity and obviates chances of misinterpretation. Besides, its frequent use prevents the grammatical mistakes, which are sometimes embarrassing. The conclusion should be displayed prominently, in bold/italics/capitals or underlined.

3.4 Illustrations

A single photograph conveys more than a thousand-word description

The firearm evidence is technical in nature. The observations are made through microscopes. The description alone cannot convey the evidence comprehensively. The evidence, therefore, is illustrated through photographs/illustrations to make them easily intelligible and convincing to all concerned.

The illustrations carry the experimental data, photographs and sketches whenever necessary.

The Gujarat High Court[1] has rightly pointed out:—

> *"It is difficult to see how any reliance can be placed on the opinion unless it is supported by good reasons founded on the facts which warrant that opinion. If the reasons are good and convincing and the factual data, on the basis of which the opinion is formed, warrant the opinion, the court will rely on the opinion. However, if the factual data is not clear or adequate or the reasons are frivolous or inconclusive, the opinion will have no probative value. That is the reason why section 51 of the Indian Evidence Act provides that whenever the opinion of any living person is relevant the grounds on which such opinion is based are also relevant."*

The photographs are not necessary for the expert to finalise findings. His main forte is microscopic examination. However, a nonprofessional cannot carry out microscopy. Besides, it is extremely difficult, if not impossible, to carry and set up a comparison microscope in a court. Illustrations and photographs, therefore, are used to demonstrate/clarify the evidence. Recent developments in digital photography have made the task effective/easier/cheaper.

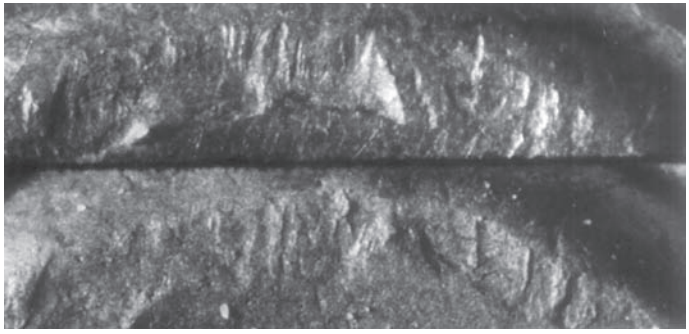

Fig. XXII-2
The ejector marks match on crime and test cartridges identifies the crime firearm - a self-loader pistol recovered from the suspect.

1. *Suleman* v. *State of Gujarat*, 1961 (2) Cr LJ 78.

The Andhra Pradesh High Court[1] rejected the evidence, which was not illustrated:

> *"With regard to the pin strike and finer striations on the base of the cap of the cartridge, the opinion expressed is definite and conclusive. However, unfortunately he has not produced the test cartridge for comparison purposes. The learned advocate on that account has argued that the data be supplied or the enlarged photos be produced so that the opinion of the expert may be verified by the court and the court ought not accept the opinion of the expert without satisfying itself of the correctness of the same.*
>
> *Learned counsel (for defence) has contended that the record does not furnish the material which has helped the expert in coming to his conclusions in this case and the court has not the advantage of looking into those materials so as to hold that the expert was justified in the opinion he has given. I think the submission must be accepted as correct."*

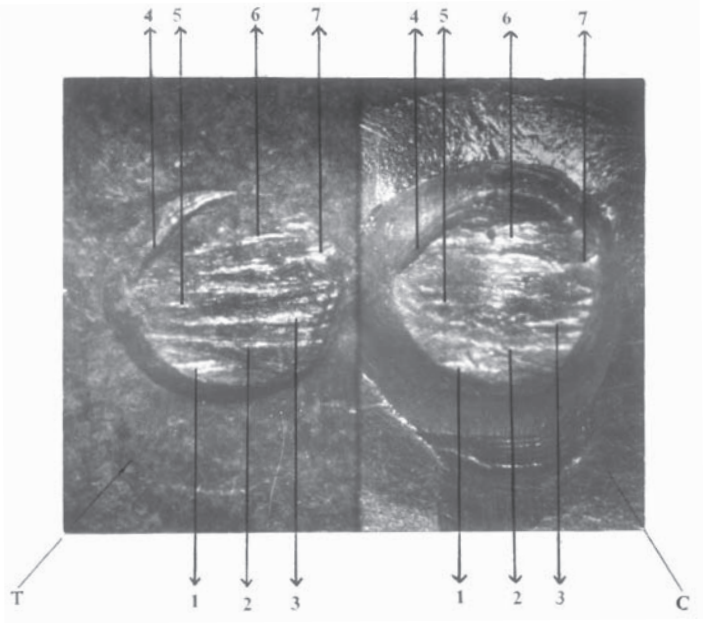

Fig. XXII-3

1. One white indentation.
2. One white big line.
3. Another white line above no. 2.
4. One cut mark in black.
5. One white island.
6. One white indentation.
7. One white island.

A usual illustrative chart. Marks obtained are not always as clear. This chart also illustrates another important point that test firing is not always necessary. In this case test marks (T) are obtained on a lead sheet struck against the firing pin.

1. *Thimma Reddi (in re:)*, 1957 Cr LJ 109 (AP).

A cartridge case may carry indentation marks and sometimes scrape marks from the firing pin. The latter are processed/evaluated/illustrated like the striation marks on the bullets. The former are illustrated through side-by-side photographs of the crime and the test cartridges, usually taken through a comparison microscope. They are pasted on a chart. The prominent indentation marks are indicated by drawing lines and giving them corresponding numbers. The notes, written on the margin of the chart, explain these marks.

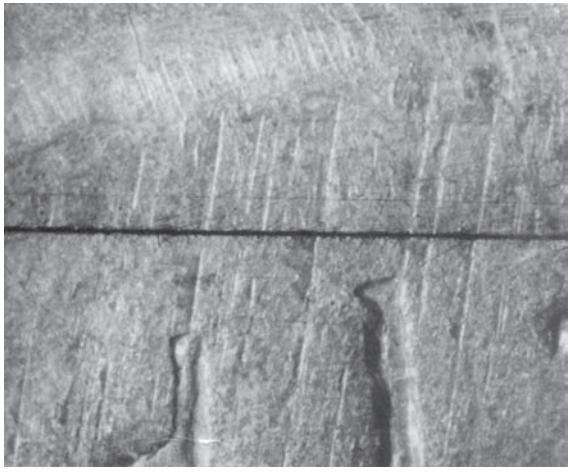

Fig. XXII-4

Marks on breech face match.

The various types of the indentations (from firing pin/breech face/chamber/extractor/ejector) are evaluated/illustrated in the same way.

Some experts produce composite/superimposed photographs sometimes. They are generally not superior to the side-by-side photographs. In fact, they sometimes confuse the nonprofessional. He cannot appreciate the small differences due to variations in pressures, developed in different shots from the same firearm.

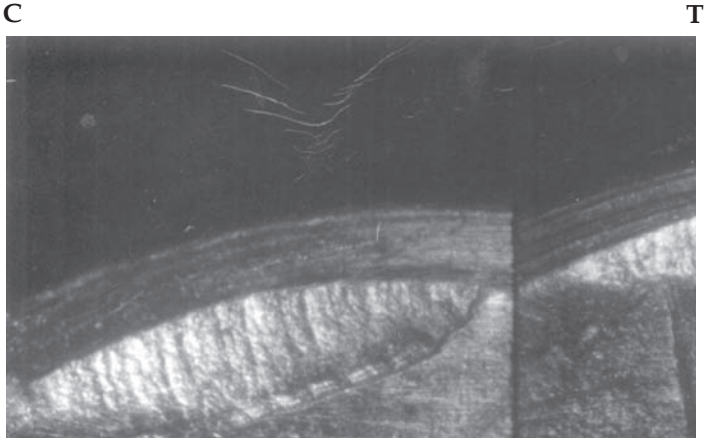

Fig. XXII-5

Matching mark of the firing pin in .22 rim fire cartridges.

The bullet identifications are illustrated through the juxtaposition/composite photographs. The prominent lines show continuation across the dividing line on the crime and the test exhibits. The photograph usually covers one groove or one land.

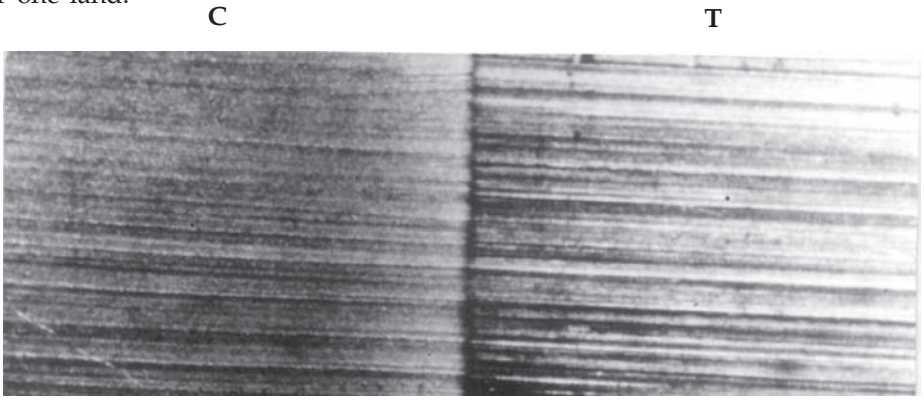

Fig. XXII-6

Striation on crime and test bullets match identifies the improvised .303 pistol as the crime weapon.

The prominent lines may be numbered. If the number of lines is inadequate, striations are compared from more than one lands/grooves.

In bullet identifications, it is not possible to give the minimum number of lines or points for a definite identification. However, a continuation of about ten lines across the dividing line is considered sufficient. There should be no substantial divergences. This is in addition to existence of matching class characteristics (diameter/the number, direction/dimensions of lands/grooves). The finer lines in the land or groove marks have a greater discriminatory evidentiary value than the wide/deep scratches.

Law of individuality dictates that a perfect duplication of marks, on test and test exhibits, is impossible even when the ammunition of the same make and batch is fired from the same firearm one after the other. Nor it is expected.

Not many non-expert professionals know that the bullets fired from the same firearm, even one after the other, will carry some non-matching striations. The expert weighs the matching/non-matching evidence and decides whether the evidence leads to identification of common source or indicates different sources. The preponderance of the matching/non-matching decides the issue. Nevertheless, a definite positive identification opinion is not given if:

a. The matching striations are less than 70%, or

b. The non-matching striations are more than 30%.

The buckshots (pellet) and ball ammunition fired from smooth bore firearms are evaluated/illustrated in a similar way.

The professionals are not able to assimilate microscopic striations evidence on photographs easily unless properly explained. They can misinterpret it, as there is never an exact duplication. There are always some non-matching

striations. The illustrations, therefore, should not be submitted if the reports are tendered as evidence, under section 293 of the Cr PC. They should be presented when evidence is being given in person as they, with the help of expert can be easily appreciated by the nonprofessional. The expert does not depended upon photographs for his findings, as they are not the total observations; they are only a part, a representative part of the total evidence.

Further, the dishonest expert can always manipulate photographs either way. The court has to depend upon the expert for faithful representation of the evidence. The practice of producing photographs as illustration, therefore, does not serve any worthwhile purpose and their production should not be insisted upon, rather it should be dispensed with. The practice is not considered essential as the enlightened judiciary and seasoned lawyers do understand the futility of the process.

The evidence relating to patterns of scorching, blackening, tattooing, deposition of metal particles and dispersion of pellets (in shotguns) is best illustrated through actual test firing on filter paper from the involved ranges. They are presented to the court. Photographs with scale, can serve as substitute. Test patterns, with the same firearm and similar ammunition, give close approximations.

Fig. XXII-7

Scraped lead particles from a lead bullet fired from an improvised firearm.

Fig. XXII-8

Contusion ring around the entrance wound.

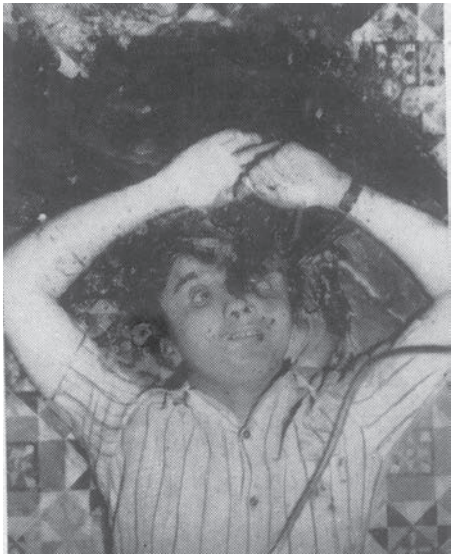

Fig. XXII-9

'Explosive' wound caused by a 12 bore shotgun from a near contact range. Part of the head is completely blown off.

3.5 Language

The expert is expected to bring the technical evidence to the level of a non-professional. He uses simple and clear language. Technical terms are avoided as far as possible, both in the report and in the statement before the court. If the technical terms are used, they are carefully explained.

In a murder trial, it was essential to establish the direction and location of the wounds for the proper reconstruction of the occurrence. The doctor who had carried out the post-mortem examination was not available. The post-mortem report was carefully studied, but it was in such technical jargons that nothing could be made out. A senior medical officer called, too failed to explain the same. (CH)

The Nagpur High Court[1] has deprecated technical verbosity:

"I do not minimise the value of expert evidence but I deprecate the attempt to cloud a simple issue in a deluge of scientific words which no ordinary man would be able to understand. The law is grounded on the assumption that the issues are ones which 'twelve good men and true' can comprehend and answer."

Three types of 'experts' use technical or pseudo-technical language:

a. Those who do not know their subject thoroughly and want to hide their lack of knowledge with technical jargons;
b. Those who are corrupt and want to confuse the court to mislead them; and
c. Technocrats; they are not court birds. However, they are always willing to explain/elucidate their findings.

It is not difficult to distinguish between the three types.

4. PRESENTING COUNSEL

The presenting counsel, who produces an expert for evidence, organizes the presentation of the expert evidence. He:

4.1 Brings *Bona Fide* of the Expert on Record

1. The presenting counsel establishes the *bona fide* of the expert. He brings on record:

a. The basic educational qualification,
b. The training,
c. The research,
d. The experience, and
e. The publications of the expert, being produced, are brought on record. This is particularly essential if the expert is new and the court does not know him. Even if the court knows the expert, it is better to record a summary of his qualifications, so that if at a later stage the case goes to a higher court in appeal, the appellate judge knows that the expert evidence has emanated from an authentic source[2].

1. *Basant Rao Baji Rao* v. *State of Maharashtra*, 1950 Cr LJ 181 (Nag).
2. *State of Bihar* v. *Hanuman Koeri*, 1971 Cr LJ 187 (Pat).

2. He assimilates the Evidence

The counsel must understand the evidence through a conference with the expert before putting him in the witness box. This is especially necessary in cases involving reconstruction of the shooting incidences to ascertain the range of fire, the time of firing and the reconstruction of occurrence (to determine whether a particular incidence was a case of murder/suicide/accident or killing in self-defence. The conference will educate the counsel about the evidence. It will avoid sudden surprises in the court. Further, it will give him time to make a connected whole of the total (oral/circumstantial/scientific/medical) evidence.

It is the counsel who co-relates the expert evidence with the rest of the evidence and present to the court the total evidence as a connected whole. He can do so only if he understands it and is able not only to show there is no contradiction in the various types of evidence *inter se* but he is also able to prove that the various pieces of evidence support one another and lead collectively to one and only one conclusion that the accused is guilty/not guilty.

4.2 Ensures that Testimony is Demonstrative

The counsel must ensure that the expert produces the data on which his findings are based. He must illustrate the findings by charts, graphs, sketches, diagrams, photographs and physical reconstruction wherever possible and whenever necessary.

4.3 Anticipates the Defence Stand

If the prosecution counsel studies the case thoroughly he is able to anticipate the defence line. He should discuss the same with the expert and cover the points, likely to be raised by the defence counsel in the cross-examination, in the examination-in-chief itself. He is, thus, able to forestall the defence. This is particularly essential and useful in those cases where the defence counsel insists on 'yes' or 'no' answer technique which often inducts ambiguities.

4.4 Is Aware of the Diminished Value of an Inconclusive Report

An inconclusive report can provide corroboratory evidence only. It alone is unable to link the crime and the criminal. The counsel should get the probative values of the inconclusive reports if the probability values are considerable.

In certain cases, the reports are, as already mentioned, inconclusive only technically. The views of the expert based upon his experience should be obtained in such cases. The replies are of a great value if the expert has an extensive experience in the field and has a reputation for honesty and efficiency.

The inconclusive report sometimes has an immense eliminative value. The experts do not often know about these possibilities at the stage of examination. The counsel should know and exploit them intelligently.

4.5 Is Attentive during Cross-examination

The counsel carrying out the cross-examination may bring forth material, which needs further elucidation or clarifications. He may direct the cross-examination in such a way that certain anomalous situations are created. It is the duty of the prosecution counsel to evaluate the cross-examination carefully and get the ambiguities clarified and removed in the re-examination.

5. DEFENCE COUNSEL

Defence Checks

1. Is the 'expert' qualified: education, training, experience, research, publications?
2. Is the 'expert' honest: reputation: ill? Demeanour?
3. Is the 'expert' an imposter, biased, over-enthusiastic, negligent?
4. Does the 'expert' abuse jargons, verbosity?
5. Does the expert circumvent/sidetrack issues?
6. Is the 'expert' conformational Syndrome addict?
7. Is there a change in the demeanour of the expert why answering crucial issues (bungling!)
8. Has the 'expert' co-related the court exhibits with those on which he based his report? How?
9. Is the' expert's opinion based on accepted standards? Authorities?
10. Is the expert's evidence convincing? Non-convincing evidence has no value!
11. Has the 'expert' distorted photographs and illustrations?
12. Has the 'expert' hid the identifying/non-identifying characteristic with indicator lines on the illustrations?
13. Has the 'expert' produced adequate data to support his thesis?
14. Has the 'expert' shown preponderance of positive/negative evidence to come to corresponding correct conclusion?
15. Has the 'expert' discussed/explained contradictory/contrary evidence?

The defence counsel plays the dramatic part in the presentation of the expert evidence. He takes over the expert after the examination-in-chief. An intelligent and conscientious defence counsel is attentive throughout the examination-in-chief. He appraises and compares the oral evidence and the written report *inter se*. He plans the cross-examination after locating and assessing the in congruencies/deficiencies/contradictions/mistakes/overstatements in the expert evidence.

A cross-examination of an expert needs thought and care. An off-hand/haphazard cross-examination often does more harm than good to the defence case. The counsel adopts the flowing line of action:—

5.1 He Assimilates/Understands the Evidence

It is not necessary for him to have studied the subject in a college or a university. However, he must acquire sufficient knowledge from the case studies and available standard works recognised and utilised by the courts as authorities. The choice of the right book(s) is, of course, important.

5.2 Anticipates the Expert Evidence

The defence counsel appraises the report of the expert, which I given to him along with other documents when the prosecution puts up the chalan and the statement on asking after the examination-in-chief. The report gives the main points of the expert evidence. However, the prosecution or the court extracts additional evidence and elucidations in the examination-in-chief. The defence counsel, therefore, should include the statement of the expert in his appraisal.

5.3 Plans his Cross-examination Carefully

Ordinarily cross-examination has one or more of the three aims:—

a. To discredit the *bona fide* of an expert.
b. To challenge the correctness of his findings.
c. To seek elucidation and additional information, which may clarify, confuse or contradict other evidence.

The counsel can organize an effective cross-examination if he knows the expert, the expertise, the evidence and the details of the case.

5.4 Checks *Bona Fide* of Expert

The weakness of the expert is exposed by exploring carefully the basis on which, he or she claims to be an expert. If the expert has claimed the membership or the fellowships of some learned societies, the questions are directed to know the nature, function and the actual work done by the society and by the expert. For example, some of these pseudo experts write against their names MFSSI or FFSSI, now a defunct society, in India. The impostor often claims degrees or diplomas of non-existing universities and institutes. It should be possible to expose the fraud.

A university professor, after leaving (removed for some forgery) the service decided to practise Forensics in courts. He claimed that in addition to his usual scientific qualifications he had a degree in criminalistics from a German University.

One of the lawyers got suspicious of the degree. He contacted the Germany Embassy. To his surprise, there was no University of the name from which the degree was claimed.

The expert was prosecuted for perjury and forgery. (CH)

Another class of pseudo experts is emerging in India. These impostors attend classes organised for police officers, lawyers and judges to appreciate the scientific evidence. After attending classes they claim to have acquired the necessary expertise, which such courses do not even pretend to teach.

In addition to the general and the basic education, four variables determine the expertise:—

1. Training;
2. Experience;
3. Research; and
4. Publications.

Doubtful credentials of the expert should be probed:

a. **In training**, the period of training, the standing of the institution where the expert obtained his training, the detailed nature of the training, the work done during the training and the training period are important. Some of the impostors have claimed even a short visit (for an hour or two) to an institution as training. Such claims are easily exposed and should be exposed.

b. **In experience**, both qualitative and quantitative experiences are important. The number of cases examined and the length of practicing the profession are important. They are ascertained. The outstanding cases handled/published/appraised by the courts are good indicators.

c. **In research**, the subject of research, the number of publications, the standing of the journal publishing the research papers, are scrutinised. The reprints of the research papers should be brought on court record.

It is futile to try to discredit an honest/efficient/well-established expert. It is also criminal to accept a slimy/dishonest/tailor-made opinion seller/impostor as an expert.

Cross-examiner's Mantra

Be mild with the mild; shrewd with the crafty, confiding with the honest, merciful to the young, the frail and the fearful, rough to the ruffian and a thunderbolt to the liar. But never compromise your dignity.

Focus fully so that virtue and truth triumphs.

Paul Brown: Harris, 1911

5.5 Evaluation of the Evidence

The evaluation of evidence, to challenge the correctness of the findings of an expert, is a difficult/delicate task. Most of the lawyers prefer to put up their own expert for the purpose. The expert helps:—

a. He cross-examines the presenting expert after getting special power of attorney.

b. He gives rebuttal evidence as a defence witness.

c. He briefs the counsel on the relevant expertise/evidence, before the cross-examination starts.

d. He furnishes questionnaire to the defence counsel for the cross-examination of the presenting expert.

e. He remains with the defence counsel, in the court, during cross-examination and furnishes additional questions to the counsel, if needed.

The services of a reliable expert are not always available. Frequently, the counsel has to carry out the cross-examination by himself alone.

The basic principles of forensic ballistics are simple and any educated person, who is willing to understand the subject, can do so without any difficulty. He has to study standard works on the subject. The study is always rewarding. The story of a famous American lawyer, Fallon, is worth recalling:—

Mr. Fallon, an eminent lawyer, once carried out a brilliant cross-examination of the head of the Gynaecology Department of Harvard University. At the end of the cross-examination, the professor asked Fallon. 'May I ask you a question'?

'Certainly', replied the lawyer.

'Where and when did you study Gynaecology, Mr. Fallon"?

'Last night in my library,' replied the lawyer.

5.6 Fundamental Explorations

The prosecution experts are often over-burdened with the casework. It prevents them from doing a thorough examination. It can lead to mistakes and miscarriage of justice. The defence counsel checks the lacunae/weak points of presented expert evidence. The check lists are as follows:

(1) Has the expert compared the crime exhibits with the test ones?

An expert testified that the crime bullet had been fired from the questioned firearm. The defence counsel knew that the firearm had not been used in the crime. He also knew that the expert was honest and experienced. He was, therefore, puzzled at the findings.

He examined the questioned bullets and the photomicrograph produced carefully. The bullet had been deformed to certain extent, whereas there was no deformation visible on the photograph of the crime bullet. He puts up his doubts to the expert. The expert gave a careful check and admitted the possible mistake. He asked for more time, which was readily given.

The re-examination of the exhibits revealed that the expert had compared, by mistake, the test bullets inter se! (CH)

(2) Does the expert identify the exhibits?

Ordinarily the expert puts his identification marks on the exhibits. The counsels should check the basis of the identification of the exhibits in doubtful cases, as sometimes the exhibits may get lost or replaced (switched).

A few years ago, a cartridge case was produced in the court, for the author's identification. It did not bear his usual initials and the other identifying scribble. The author was puzzled. However, he had a photograph of the base. He compared the same with the base of the cartridge produced. The two did not tally! Later, it was found that the original crime cartridge had been lost and the person responsible for the custody presumably introduced the substitute! (CH)

(3) Has the expert based his opinion on the accepted standards?

The defence counsel ascertains the accepted standards, pertaining to the evidence in hand, e.g. proof of practical identity in the comparison work. He had already done the library work and noted the prevailing standards from standard/current sources (Old works in science become dated and obsolete). He compares the two. If the standard of proof of the expert is substantially lower than that given by the authorities on the subject, it is brought on record.

In some cases, the data furnished is too perfunctory to inspire confidence and hence acceptance.

(4) Is the evidence produced by the expert convincing?

The illustrations, graphs, charts, photographs and the data are produced to convince the court and the counsels, in general. If they are not clear and intelligible, they are useless. The unintelligible presentation cannot convince! However, the counsel has to be familiar with the type of evidence, so that he does not expose his ignorance.

The counsel continues to explore until he is convinced either way.

The defence counsel must have an honest 'open mind' approach with the expert evidence. The 'closed-door' approach (where the counsel rejects whatever the expert says) does not help. The courts are quick to detect the latter approach. The court becomes sympathetic towards the expert. The defence counsel creates a bad feeling in the bargain.

(5) Has the expert carried out adequate tests and experiments?

Ordinarily, the expert carries out all the essential work. In rare cases only, he may neglect the necessary experiments (due to carelessness, over-work, illness or due to bad intentions). It is often difficult to ascertain the reason. However, a careful scrutiny of the evidence, *via* cross-examination, reveals the lacunae**.**

(6) Are the exhibits authentic?

It is difficult to ascertain whether the exhibits were safe in the laboratory. However, the expert must certify that:—

(a) He received the exhibits in sealed conditions. The seals were intact and tallied with the specimens, supplied separately.

(b) He opened or got the packets opened in his presence and that he put his identification marks, then and there.

(c) The exhibits during the examination remained in the personal custody (lock and key) of the expert and nobody has/could fiddle with them.

(d) He sealed or got the exhibits sealed after the examination.

(e) The exhibits in the court are the same, which he examined in the laboratory.

If the exhibits carry signatures of the recovering officer and of the recovery witnesses, the task of identification of authenticity is simplified.

(7) Is the expert biased?

It is a difficult to ascertain if the expert is biased. It is general feeling that a government expert is biased in favour of prosecution and a private expert is biased towards the party employing him. It need not be so. In fact, the circumstances are such that the expert looks biased. The prosecution or the private party calls an expert for evidence only after it has ascertained that the opinion is favourable to the concerned party. If the opinion is not favourable, the party does not call the expert. It is only rarely that the opposite party comes to know about the results and calls the expert as their witness in such cases. The courts also call the expert now and then as a court witness.

The firearm evidence is verifiable. It leaves no room for bias.

The question of bias, therefore, has little relevance. In case of doubt, the case is referred a second or even a third expert.

Usually two honest experts give same findings, almost invariably, pertaining to fundamentals, though they may differ slightly in minor details.

Some years ago, the author received a case from Madhya Pradesh. Some expert had already examined the case but the author was not informed about the findings. The examination linked the fired ammunition with the firearm.

When the author appeared for evidence, he found that another expert, from UP had examined the case, after my examination. The report of the state's expert was also on the case file. It was found that the last two reports corresponded. They differed from the report of the state's expert.

It was evident that the state expert had bungled! (CH)

(8) Additional Details

It is often useful to ascertain additional details. They may contradict the medical evidence or the evidence of the eyewitnesses Thus; they may cast a doubt in the minds of the court: which is likely to benefit the accused. Examples:—

1. *In a case of murder, a 12-bore shotgun cartridge, made by the Indian ordnance factory, the investigator allegedly recovered a fired cartridge case from the scene. The author identified that it had been fired from the firearm recovered from the suspect accused.*

   The defence counsel, at the time of cross-examination, showed the author the felt cushion wad recovered from the dead body of the victim. The Indian Ordnance Factory had never made cartridges with felt wad. Obviously, the cartridge case had been planted (padding!). (CH)

2. *In another multi-murder case, the evidence of an eyewitness was believed because he was also allegedly injured in the shooting. The medico legal expert had X-rayed the injury and taken out foreign material from the injury. On the request of the defence, the author examined the X-ray picture and the extracted material. He did not find any projectile or its fragment in the extracted material, nor did he find any shadow of a projectile or its parts in the X-ray film. (CH)*

6. THE COURT

A. The judge checks the evidence

1. Relevancy: belonged to the case.
2. Identity: Correct clue/site/time/collector/witnesses.
3. Collection: Correct place/mode/witnesses.
4. Authenticity: certified.
5. Integrity: Correct preservation: no loss/substitution/ contamination/destruction/disintegration.
6. Packing/sealing: untampered.

7. Standards: Correct/adequate/acceptable to the concerned.
8. Unbroken Chain of custody.
9. Documentation: Complete: videography/photography/sketches/ Textual description.
10. Acceptability of expertise to fraternity.
11. Expert's performance/demeanour : normal, fidgety?
12. The quality of the presentation: data/illustrations/demonstration.
13. To reconcile the ambiguities/deficiencies.
14. The blanksand remove them through court questions!
15. The adequacy of the supporting data.
16. The margin of error.
17. Takes care of lacunae.
18. Checks authorities (technical citations).
19. The presentation is convincing.

B. The judge checks the Expert

1. Academically qualified/sound?
2. Trained at reputed institution for adequate period?
3. In-service attachment?
4. Joint examination?
5. Experience?
6. Dedicated?
7. Research experience, publications/participation in sci. meet?
8. Cases examined?
9. Beyond conformational Syndrome?
10. Adequate inputs?
11. Data, illustrations, adequate?
12. Evidence convincing?

The court is the ultimate authority to evaluate and utilize the expert evidence. The attitudes of the courts vary tremendously. Some courts:

(a) They underrate Ballistics expert's evidence. They feel it is weak evidence.

(b) They are hostile towards scientific evidence. They feel that the expert assumes the functions of the court.

(c) They fear expert evidence. They feel the evidence is too technical to be their cup of tea. They either ignore it or accept the *ipse dixit* of the expert.

(d) They believe that the evidence is not their worry. The counsels should understand and argue about it. The court should decide the case on their arguments alone. Such attitudes are undesirable as they allow the loud mouth to win.

(e) They give importance to the evidence. They assimilate it and utilize it in deciding the case. Numerically they are rather few in number.

The scrutiny of ballistic evidence by the court is necessary:

Firstly, the evidence can turn the tables. A suspected criminal may prove to be an innocent person and *vice versa.*

Secondly, most of the lawyers, on both sides feel shy of the evidence. They may fail to properly present or critically appraise the evidence, which may lead to injustices.

Thirdly, a clever lawyer may exploit the general lack of knowledge to twist the evidence to his advantage and misuse it.

Fourthly, the prosecution counsel usually does not take interest. The defence counsel exploits his indifference and presents a lop-sided view of the evidence.

Fifthly, the defence counsel is interested in his own case only. He limits his probes to an extent, which is beneficial to the defence case. He is interested only in demolishing the prosecution evidence, rightly or wrongly. He is not interested in extracting the truth.

6.1 The Role of the Judge

It is the judge only who has to find truth, assimilate it and utilize it in the dissemination of justice. The newer generation of judges should be more aware of their responsibilities and use scientific evidence more frequently.

The scientific methods in the detection of crime are daily improving and are becoming accurate, sensitive and specific. At no stage, they are unintelligible. The court must utilize them.

In brief, the court must see that:—

(a) The expert, the prosecution and the defence have done their duties properly, if they have not, the court should intervene at the appropriate time to get at the truth.

(b) The integrity of the expert is above reproach and that he is properly educated, trained and engaged in Forensic Ballistics work. The court should not permit an *impostor* to impose upon the court and perjure.

(c) The expert does not use meaningless *jargons, technical terminology or verbosity* to hide the weak points in his evidence or to mislead the court to non-issues.

(d) The expert is not forced to answer questions in *'yes' or 'no'* answers. The scientific evidence often needs elaboration. 'Yes' or 'No' answers cannot do justice to the truth in some of the questions.

(e) The expert has not *sidetracked* the relevant questions put to him.

(f) The counsels do not waste time in asking *hypothetical questions.*

(g) The expert evidence produced is *relevant, intelligible,* properly demonstrated and explained and conform to the standards in the specialty.

(h) The points left *ambiguous or incomplete,* either by the prosecution or by the defence, are clarified through court questions.

(i) The inconclusive reports are probed to ascertain their *probative values* and they are given due weightage accordingly. As already mentioned elsewhere, some of the reports are inconclusive only technically. They must be given due consideration.

7. FALLACIES ABOUT EXPERT EVIDENCE

There are certain court conventions, which need some elaboration, to prevent their misused. Some of the important ones are:—

7.1 'Court must form its Own Opinion'

That the 'court must form its own opinion' is a time-honoured convention. It provides a useful check and prevents the carelessness and complacency on the part of the expert. However, the court is not to act as a super expert. The court has to form an opinion on the total evidence and not on the expert evidence alone. Some persons feel that the court is the super expert and has to be an expert over experts. It must be reiterated that the court is not a super expert. If it is not satisfied with the evidence of an expert, a second or even a third expert may clear the doubts.

The convention is irksome to some experts. They believe that the firearm evidence is too technical to be understood by other (the judges, the lawyers) than ballistics experts. The belief has no basis. The author's experience, literally in thousands of cases, indicates that it is always possible to bring the evidence to an understanding level of an educated person provided he is willing to understand. Some judges and some lawyers, unfortunately, refuse to do so.

The convention ensures that the evidence is descriptive, demonstrative and in non-technical language. If the reports of the expert are considered 'sacrosanct' and accepted without any scrutiny, the practice may harm the cause of justice.

Unfortunately, some judges misconstrue the convention. They take up the role of the expert and form their own judgments on technical issues. This is an incorrect approach. The essence of the convention is that the judge should not accept the *ipsi dixit* of the expert. He must understand the evidence (with the help of another expert, if necessary) before using it along with the other evidence for adjudication.

7.2 Eyewitness Bias

The judge has a sub-conscious (even conscious) preference (or is it bias?) towards the evidence of the eyewitnesses *vis-à-vis* experts, including Forensics ballistics experts. It is in spite of the numerous infirmities of the eyewitness accounts: wrong observation, memory failure, 'rationalization', bias, threat from the affected party, fear of the court, etc. The Horse's Mouth Syndrome certainly rules the evidential field; even in the face of the dictum: '***facts do not lie, men can and do***'. The forensic evidence is certainly superior to the eyewitness accounts, provided the investigator and the expert have done their work properly and have not bungled.

7.3 'The expert must conform to "yes" or "no" technique'

Some defence counsels want the expert to answer their questions in 'yes' or 'no'. 'Yes' or 'no' answers, in expert evidence, can be given only at the cost of accuracy and clarity. They are likely to confuse the issues. The court must see that the expert is allowed proper opportunity to amplify and to clarify his testimony whenever he so desires so that the incomplete evidence does not create confusion. If the defence counsel objects, the clarification may be dubbed as 'volunteered'.

7.4 'The expert must answer all questions'

The expert must answer all the relevant questions relating to the evidence in hand. However, given a free reign, the counsel often pesters the expert with hypothetical questions, which lead to confusion. Wigmore, an authority on evidence, has remarked:—

> *'Hypothetical questions are misused by the clumsy and abused by the clever. They have in practice led to intolerable obstruction of truth'.*

7.5 'Expert testimony is weak evidence'

Expert testimony is not opinion evidence of a non-professional. The expert carries out experiments, observes their results, studies precedences and then draws his inferences/conclusions. They are verifiable. Therefore, the expert testimony is a report of facts. It is not opinion evidence, in the usual sense.

7.6 Proof beyond 'Reasonable Doubt'

Reasonable doubt has not been quantified or well defined. In fact, what is 'Reasonable Doubt' is highly subjective. It varies with each person. It is why some judges are called "convicting judges" and others are called "acquitting judges". There is a need to fix some criteria by which 'Reasonable Doubt' should be the same with different judges. Perhaps it is a difficult task. With Forensic evidence, the quantum of 'reasonable doubt' can be reduced largely.

The advent of Forensics, its researches and its tools and techniques have worked wonders. The quantum of **'Reasonable Doubt"** is almost finished unless fear of the unfamiliar and the fantasy is allowed to rule the roost.

7.7 'Expert usurps court's functions'

The expert does not/cannot usurp the function of a court because he handles only a part of the evidence. He may not even be aware of the rest of the evidence. The court on the other hand has the total evidence to work with. Naturally, the allegation is ill founded.

In this connection the words of Rogers, another famous authority on evidence are worth noting:—

> 'The proper test of the admissibility of the expert is not whether or not the opinion of the expert would prove the very fact to be found by the jury (court). The object of all testimony is to prove the very fact to be found by the jury and it is not usurpation of powers of the jury to prove that fact'.

EXPLOSIVES AND EXPLOSIONS

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EXPLOSIVES AND EXPLOSIONS

Fig. XXIII-1

September 11, 2001 attack on World Trade Center: burning

1. EXPLOSIVES

The Explosive Act, 1884 as amended in 1978, has defined 'explosive' elaborately[1] in the following words:

> *"Explosive means gunpowder, nitroglycerine, nitro glycol, gun cotton, di-nitro-toluene, tri-nitro-toluene, picric acid, di-nitro-phenol, tri-nitro-resorcinol (styphnic acid), cyclo-trimethylene-trinitramine, penta-erythritol tetra-amine, nitro-guanidine, lead azide, lead styphnate, fulminate of mercury or any other metal, diazo-di-nitro-phenol, coloured fires or any other substance whether a single chemical compound or a mixture of substances, whether solid or liquid or gaseous used or manufactured with a view to produce a practical effect by explosion or pyrotechnic effect, and includes fog signals, fireworks, fuses, rockets, percussion caps, detonators, cartridges, ammunition of all descriptions and every adaptation and preparation of an explosive as defined in this clause."*

1.1 Uses of Explosives

Explosives have many legitimate uses, both for civil and military purposes. In civil works, they are used, mostly, for:

1. Section 4 of the Explosive Act, 1884 as substituted by Act 32 of 1978 and operative with effect from 2-3-1983.

1. Fireworks on festivals and marriages and inauguration of mega events like Olympic Games, for coloured lights display, sound signals, etc.
2. Mining of minerals.
3. Blasting of rocks and earth for the construction of roads, railway lines, dams, tunnels, pipelines, buildings.
4. Spacecraft and satellite propulsion.
5. Oil explorations.
6. Extinguishing oil wells' fires.
7. Demolition of old derelict structures.

   A few years ago, one of the oil wells caught fire. The firefighters struggled for 42 days to put down the fire but to no avail. Ultimately, the fire was put down by exploding 200 Kg of high explosive at the site. The explosion extinguished the fire. (CH)
8. Ammunition for small arms: for hunting, self-defence or in armed conflicts.
9. Other minor uses include heating food, lifting loads, welding; drain blockage testing, tear gas shells to control mobs, and the like.

Defence forces of all countries use explosives in large quantities in their defence (and offence) systems, mainly for:

1. Ammunition for their small arms and artillery.
2. Grenades, bombs.
3. Smoke screens, etc.

1.2 Abuses of Explosives

The abuse of explosives is extensive. The terrorists misuse them to inflict heavy losses of life and property to public and governments. They exploit explosives in sabotage, communal riots and political vendetta/troubles. Criminals abuse them for murders, dacoities, revenge killing, burglaries, etc.

A very rich person could spend pots of money on the wife of one of his friends, a military officer, when the latter was away on duty. The wife was so enamoured by the person that she abandoned the officer and started living with the businessperson. The officer was upset. He took revenge; he sent a parcel bomb, which killed the paramour. (CH)

The abuse of explosives, in India, was not common up to the late eighties of the twentieth century. The criminals did use them sometimes to open safes and money chests or to damage railway tracks to loot trains. Usually low explosives were used.

Terrorism has completely changed the scenario. Every other day there are explosions in the terrorist-affected areas, killing and maiming scores of persons, destroying cars and buses and other property worth sometimes crores of rupees!. The Mumbai blast (1993), twin rower blasts of New York (2001) and the continuing spate of suicide bombings in Pakistan and elsewhere are examples.

TABLE XXIII-1

New York Twin Tower Blast
(September 11, 2001)

Persons killed	~3000
Repercussions	Started a limited War in Iraq/ Afghanistan
Property Damaged/destroyed (Approx.)	Hundreds of Billions dollars

a. The whole of FBI department worked day and night for weeks. A substantial force continued for months later. A large number of investigators continued working even for more than a decade after years.
b. It brought USA to a grinding halt for days together.
c. It pulled down the stock markets of the world.
d. It brought in serious racial/religious conflicts.
e. USA spent a lot to hunt the mastermind Osama Bin Laden and eliminate him.

TABLE XXIII-2

Mumbai Blast
(March 13, 1993)

Persons killed	257
Persons injured	713
Property Damaged/destroyed	~ Rs. 27 crores
Accused challaned	204
Time taken for investigation/trial	~ 15 years

Terrorists are abusing explosives increasingly for sabotage, political and communal vendetta. The latest terrorism wave in Pakistan is a stern reminder about the shape of things to come:

TABLE XXIII-3

Main Explosions in Pakistan in one month
(October, 2009 Figures)

Date	5	9	11	12	15:3	**16**	**20**	**23**	**28**
Place	Islamabad	Pesha-war	Army GHQ	Shangl	Lahore Police	Peshawar CIA	Islamabad Islamic University	Kamra Aeronau-ticalcomplex	Pesha-war
Dead	5	54	19	41	27+11+ 1 =39	15	7	9	117

The terrorist are using all means of transport to carry explosives to the targeted site. It was carried on the person of the suicide bomber in the case of the murder of Rajiv Gandhi. The usual targets are trains, buses, hotels, government buildings, police stations, public places, army installations, etc.

The reasons for the extensive abuse of explosives are:

1. **Easy availability** of the explosives or their components.
2. **Easy improvisation**; explosives can be manufactured from common materials available in the markets.
3. **Massive supplies** of high explosives (RDX, TNT, etc.) to terrorists by hostile neighbours.
4. **High explosives** are safe to store, transport and work with.
5. **Cost-effective indigenous explosives:** The common active ingredients of the indigenous explosive devices are ammonium nitrate (a fertilizer), potassium chlorate, etc. They are not only cheap but are also easily available. Besides, the assembling of Improvised Explosive Devices (IEDs) does not involve high technical expertise.
6. **Easy to carry and hide**. Common items have been used as containers for explosives, to hoodwink the observer. Ordinary suitcases, bags, transistor frames, postal parcels, cycles, tiffin boxes, milk-cans, cars and even trucks have been used to carry, hide and explode bombs at the chosen sites.
7. **Sophistication in initiation** has gone very high. Remote or delayed time initiations are quite common.

   A district police officer (a SP) was killed through an IED (Improvised Explosive Device). It was placed in a waste paper basket in his office. The terrorists exploded the bomb from outside, from a safe distance, with a remote device. (CH)

   Suicide bombing is the latest trend in abuse of explosives**.** The new concept of the exploding human bomb is quite abnormal. Yet it is very effective. Suicide bombers ***(Fidayeen[1])***, the human- initiator, have taken over the big job. What is the cost of the human-initiator is not known. However, in term of grief to the members of the blown-off ***Fidayeen*** must be heart rending. The number of human-initiators is increasing.
8. **Little residual evidence** is left after the explosion, and that too is hidden and contaminated in heaps of debris, which are left after the explosion.
9. C**reate panic and fear** among the victims and onlookers, which is the main objective of the terrorists.
10. **Choice of time and place;** the culprit chooses the time and place. The choice of the same is so unpredictable that they create fear psychosis among a large section of the society. It affects public morale and efficiency.
11. **Effective** in most of the crime. They are the first choice of the terrorists/ criminals.

The abuse of explosives is a serious offence. The law provides severe punishments to the perpetrators. However, they seldom live to face the trials.

1. Persons who are ready to die for a misconceived cause.

2. NATURE

An explosive is a substance, which on receiving an impulse undergoes rapid changes – decomposes or transforms emitting energy in the form of pressure, light, heat. It confers with the expanding gases and other decomposition products impart kinetic energy to materials, which come in their way. The decomposition and conversion of the explosive to other substance(s) is extremely rapid and self-sustained.

The explosive may be an element (Uranium), a compound (TNT, RDX) or a mixture (black powder, chlorate or nitrate mixtures). The explosive, on explosion, produces energy (kinetic energy, heat, light, pressure, etc.), which causes the destruction observed at the explosion sites.

The explosive substances, encountered in criminal investigation, are usually chemical compounds or their mixtures. Their main characteristic features are:

1. **Chemical instability-**An explosive substance is internally unstable. The instability of the substance leads to rapid decomposition or transformation on receiving an impulse.
2. **Self-sustenance–**An explosive undergoes a self-sustained chemical change. It is their rapid burning or decomposition (lead azide). Carbon, hydrogen and other elements in the explosive substance or mixtures provide fuel for the explosive change and nitrogen oxides provide oxygen to support the burning. The solid/liquid explosives change mainly into gaseous products.

   Nitrogen oxides form part of the unstable compound or of a constituent of the explosive mixture, in combined form. It is thus, a self-sustained chemical change.

   In mixtures like black powder, potassium nitrate provides oxygen to the mixture. Other oxidants (Nitrates, chlorates, perchlorates, nitrites, permanganates, chromates and dichromates, etc.) are also be used.

Certain explosives, like azides of metals (for example Lead Azide), do not contain oxygen. The decomposition of the molecules provides sufficient gas (nitrogen) and heat to give the explosive effect. The usual combustion does not take place.

Additional characteristics of common explosives are:

1. They are sensitive to one or more of the following energy impulses:
   a. Friction.
   b. Impact.
   c. Electric Charge.
   d. Heat.
2. Most of the common explosives have nitrogen as a component of the molecule. Nitrogen confers instability to the explosive substance.
3. Most of the explosives, after the explosion, leave very small amounts of residues.

4. Explosives can be made easily. The raw materials for their manufacture are easily available.
5. The volume of the products of explosion is many times the volume of the explosive used.
6. Low explosives deflagrate[1] Deflagration is comparatively slow burning, at subsonic velocities
7. High explosives detonate[2]. The velocity of burning of explosives is extremely rapid.

Nuclear explosions depend upon annihilation of matter for their explosive action. Thus, in nuclear explosions unstable atoms undergo decomposition in a chain reaction, producing intense heat, light and radiation. The surroundings expand suddenly and cause destruction.

Fig. XXIII-2

Atom bomb cloud at Hiroshima in 1945, the first bomb explosion

In a thermo-nuclear reaction, hydrogen gas (or other substance) 'fuses', at temperatures generated by nuclear decomposition, to form helium gas (or other substance). The fusion reaction involves annihilation of matter. The matter is converted into heat, light and other radiation energy to cause extensive destruction.

Aerosol explosions occur when gas (from gas cylinders), vapours of inflammable liquids (like petrol), other combustible gases and organic dust (like flour) form explosive mixtures with air under certain conditions.

The explosion of the twin towers of the World Trade Centre, in New York, on Sept. 11, 2001, is a revelation. No normal explosive was used. The fuel of the two

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1. **Deflagration** is characterized by a subsonic flame propagation velocity, typically far below 100 m/s (220 mph), and relatively modest overpressures, say below 0.5 bars (7.3 psi).)].
2. **Detonation** is burning of high explosives at supersonic propagation velocities [up to 2,000 m/s (4,500 mph)] and creation of substantial pressures [up to 20 bars (290 psi.)]

passenger aircraft, which struck the buildings, exploded and destroyed not only the second tallest buildings of the world and killed thousands of persons, but also created the greatest panic among the people of the superpower.

3. CLASSIFICATION

The explosives have been classified in *'The Explosives Rules, 1983, Schedule I'* as under:

TABLE XXIII-4

Classification of Explosives

1.	Class 1	Gunpowder
2.	Class 2	Nitrate Mixture
3.	Class 3	Nitro Compound
4.	Class 4	Chlorate Mixture
5.	Class 5	Fulminate
6.	Class 6	Ammunition
7.	Class 7	Fireworks
8.	Class 8	Liquid Oxygen Explosives (LOX)

The classification is rather loose but convenient from the legal point of view. Other classifications are based upon various features of explosives as under:

3.1 Speed-Based Classification

Explosives are divided in two classes according to the speed of explosion:

1. Low Explosives or Deflagrating Explosives.
   (Burning speed is 200 to 900 m/s. May go up to 2000 m/s)
2. High Explosives or Detonating Explosives.
   (Detonating speed 2000 to 9000 m/s)

(1) Low Explosives

Strictly speaking, low explosive burn rather than explode. However, they burn very rapidly. Usually the burning speed is 200 to 1000 m/s. They produce gases rapidly and increase pressure on the surroundings in confined spaces. Gunpowder, nitrocellulose and cracker compositions are usually low explosives. These explosives are used to manufacture propellants for small arms, fireworks, etc. They do not shatter the containers, if properly manufactured, handled and controlled.

Low explosive, however, can behave like high explosive under certain conditions. For example, gunpowder initiated in closed containers, can act as a high explosive.

(2) High Explosives

High explosives detonate (explode) at very high speed: 2000 to 10000 m/s. They shatter the container and have a shattering effect on the surroundings. The explosive wave is directional. The direction taken is the one of least resistance.

Common high explosives and their detonation speeds are in the table below:

TABLE XXIII-5

Detonation Speed of Explosives

Explosive	Detonation Speed (m/s)
1. TNT	8250
2. RDX	8180
3. PETN	8300
4. Tetryl	7850
5. Amatol	6430

3.2 Sensitivity-Based Classification

Based on sensitivity, the explosive are divided into two classes:

a. Primary Explosives.

b. Secondary Explosives.

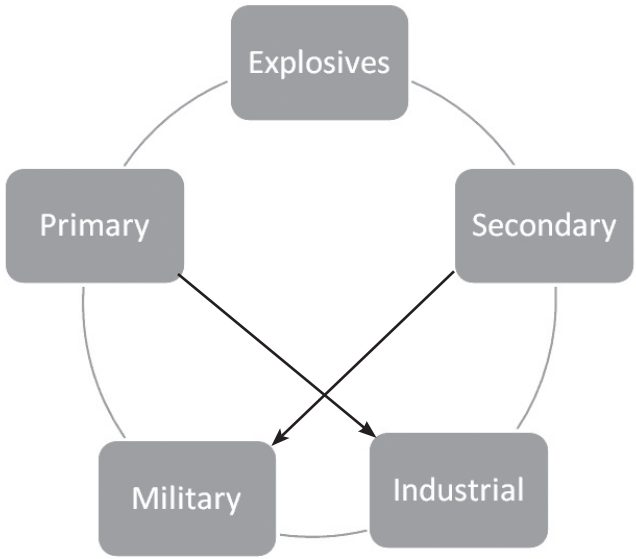

Fig. XXIII-3

Explosives and their applications

1. Primary Explosives

Primary explosives are highly sensitive to various stimuli: impact, heat and friction, and are easily initiated with an electric spark or direct flame. The primary explosives do not deflagrate, they detonate. They are used only in small amounts as initiators in firearm ammunition, blasting caps and detonators or to initiate, sensitise and explode the secondary explosives. The latter form the main charge of powerful explosive devices. The primary explosives are initiated by impact, by an electric spark or by stabbing the primary charge.

Working with primary explosives in substantial quantities is hazardous because of their high sensitivity.

The important common primary explosives are:

1. Mercury fulminate.
2. Lead/Silver azide.
3. Lead styphnate.
4. Tetracene (Tetrazene).
5. Dinol (Diazo-dinitro-phenol).

2. Secondary Explosives

Secondary explosives are comparatively insensitive; hence, they are safer to manufacture, transport and work with *vis-à-vis* the primary explosives. They normally require a small charge of primary explosive as detonator to explode.

The common secondary explosives are TNT, RDX, HMX, PETN, etc.

3.3 Use-Based Classification

The third classification of explosives is based on their use, abuse:

a. Industrial Explosives.
b. Military Explosives.
c. Pyrotechnics.
d. Propellants.
e. Non-explosive Explosion Mixture.
f. Nuclear Explosive.
g. Miscellaneous.

1. Industrial Explosive

Industrial explosives are loosely known as dynamites. They are modifications of the original dynamite prepared by Alfred Nobel. Nobel prepared the first dynamite from nitroglycerine, a highly sensitive explosive liquid. The sensitivity of the explosive is so high that it does not permit safe handling during its use. Nobel reduced its sensitivity in a very simple way, simply by adding Kieselguhr earth (diatomaceous earth) to nitroglycerine. He found that a mixture consisting of 25 parts of nitroglycerine and 75 parts of the earth gave the best results. The results brought in pots of money with which he created a trust, which has been awarding Nobel prizes for the globally best contributions in various fields of activity.

A number of formulations with or without nitroglycerine have come up and 'dynamites' are being manufactured according to those formulations. Common formulation are given in the table XXIII-6

TABLE XXIII-6

Dynamites

Name of Dynamite	Composition
1. Straight Dynamite	NC (Nitrocellulose) + EGDN (Ethylene Glycol Di-nitrate)
2. Gelatin Dynamite	NG (Nitroglycerine) + EGDN + NC (nitrocellulose)

2. ANFO

Dynamites are no longer the favourites for industrial purposes. From the early fifties they have been replaced by explosives containing ammonium nitrate as the main active explosive ingredient, Ammonium Nitrate (94%) and Fuel Oil (6%), nicknamed ANFO (acronym) being the most popular and widely used mixture. It is cheap, safe and easy to handle, yet powerful. A number of formulations have come up for ANFO explosives.

3. Slurry Explosives

Slurry explosives are essentially ammonium nitrate explosives turned into slurry by the addition of water and a gelling agent. Sometimes sensitizing agents are also added.

4. Water Gel Explosive

The water gel explosives do not contain NG. They are solution of nitrates containing water (15%). The following compounds are the main explosive ingredients for water gel explosives.

a. Ammonium Nitrate.
b. Calcium Nitrate.
c. Sodium Nitrate.

In addition, they contain stabilisers and gel forming agent. Some water explosives also contain Aluminum (for energy), TNT or aliphatic amine nitrate (for sensitization), etc.

5. Explosive Emulsions

Explosive emulsions are usually made of inorganic nitrate, Ammonium or Sodium Nitrate (AN or SN) mixed with fuel oil, wax and emulsifier. The mixture is made sensitive with air bubbles (through tiny plastic bubbles). In some preparations, Nitrocellulose (NC) and Ethylene Glycol Dinitrate (EGDN) are also added for sensitisation. Two typical formulations are

1. **Nipak:** Ammonium Nitrate + Sodium Nitrate + Tetrachloride+ polyurethane + Aliphatic amine nitrate with plastic bubbles
2. **Emulex:** AN+SN+Al + oil with emulsifier + micro bubbles.

Industrial explosives are used mainly for blasting. Important members are dynamites of various compositions (and strengths). Gelatins, gelignite and ANFO are common.

Emulsion explosives are popular for blasting purposes. They have high speed because of their particle size. They can be used in wet or water-filled holes, as they are also available in waterproof form

3.4 Military Explosives

Military explosives are mainly TNT, RDX, PETN, Tetryl and HMX. The first three are the most popular. Military explosives are usually used in mixtures. For example, RDX is used in the following well-known compositions:

TABLE XXIII-7

Military explosives

Name		Composition
1. A-3	=	RDX + Wax
2. B	=	RDX + TNT + Wax
3. C-1	=	RDX + Plasticiser[1]
4. Cyclotol	=	RDX + TNT
5. PTX-1	=	RDX + TNT +Tetryl.
6. PTX-2	=	RDX + TNT + PETN
7. Pentilite	=	PETN + TNT
8. Terytol	=	TNT + Tetryl
9. Tritnol	=	TNT + AL
10. Picratol	=	TNT + Am. Picrate
11. Octol	=	HMX + TNT
12. Delta sheet	=	PETN + Platiciser

The variety of the military explosives is legion. The number is increasing. The compositions and formulations also vary, not only with different brand names but also with various batches of the same explosive mixtures. Some formulations are secret.

3.5 Pyrotechnics

Pyrotechnics employ an explosive mixture, based mainly upon gunpowder, aluminum powder, barium nitrate, magnesium powder, nitrate mixtures, etc. A large variety of pyrotechnic items is available in the market and new products are being introduced continuously.

Before pyrotechnic products go to the market, the authorities inspect the products. Each product has to conform to the specifications laid down by the Chief Controller of Explosives *vis-à-vis* its composition and structure. The nature of the explosive as well as the quantity of the explosive used has to conform to the directions of the authorities. In fact, the pyrotechnics item of a firework product leaves leave the premises only after the approval of the Inspector of Explosives. The use of chlorates mixtures is prohibited in fireworks.

The pyrotechnics are supposed to be innocent items for fireworks display on festivals, birthdays, marriages and other celebrations. However, in order to increase the popularity of their brands the manufacturers cross the safety limits frequently.

Unauthorized manufacture and negligence in the manufacturing processes further brings in changes, which may cause serious accidents. Further, the users, usually children, due to a 'couldn't-care-less' attitude, worsen the situation and make the problem still more serious. Hundreds of children suffer injuries every year. A stringent control on the manufacturer and vigilance on the part of parents is essential.

1. C-2/C-3/C-4 are similar.

In a case of accident while playing with fireworks, a child of ten years lost both his eyes. He was playing with a legally manufactured, hence authorized, cracker.

The author examined a number of crackers of the same make and model. It revealed that clay was used to plug the two ends of the paper tube forming the body of the cracker. A series of experiments with the crackers showed that due to excessive use of gum in the clay (not specified in law), had hardened pieces and turned them into lethal missiles. After they were partially baked by the heat of the explosion.

Experiments with the similar crackers showed that the pieces of the hard clay flew to long distances, even to 15 metres in all directions. If these pieces hit any person in the eyes, they could cause serious damage to the eyes, as had happened to the boy.

It appears that the hardening of the clay plug due to excessive use of gum was principally responsible for the serious accident. (CH)

3.6 Propellants

Propellants are used in ammunition and have been discussed in some detail elsewhere in this book[1].

3.7 Aerosol Explosive Mixtures

Non–explosive explosive mixture are formed by combustible gases like NG (Natural Gas), LPG (Liquefied Petroleum Gas), volatile inflammable liquids and combustible organic dusts, when they are dispersed in the air in a confined space and a spark or flame is applied to the aerosol. Household gas (LPG) cylinders explosions are on the increase.

4. INDIVIDUAL EXPLOSIVES

4.1 Black Powder

Black powder is also known as gunpowder. It is perhaps the oldest explosive known to man. Its details are given elsewhere[2]. In addition to its use as propellant in homemade cartridges and muzzle-loading guns, it is used in mining for blasting, in safety fuses or fuse cords, in crackers and fireworks. It is also used in IEDs.

Black powder is an intimate mechanical mixture of nitrate of potassium (or sodium), sulphur and charcoal. It can be identified by identifying its constituents. When it is treated with water, nitrate is dissolved and can thus be separated and identified from the solution.

Potassium nitrate is identified from the colour of its flame (orange-purple) or by instrumental methods.

Sulphur dissolves in pyridine, when the residue, after removal of potassium is stirred with the solvent. Filtration removes the charcoal from the sulphur solution. Evaporation of the solution gives sulphur, which is identified from its colour, crystals and burning. Burning gives sulphur dioxide.

Charcoal is identified from its colour, non-reactivity and burning.

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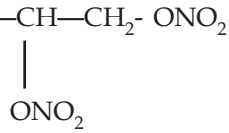
1. Kindly *see* chapter 3.
2. Kindly *see* chapter 3 of this book.

4.2 Nitroglycerin [$C_3H_5(NO_3)_3$]



Nitroglycerin is a pale yellow liquid. In pure form, it is an extremely sensitive/dangerous/powerful explosive. It is mixed with inert/less reactive materials before use. Its modified forms, in use, are:

a. Cordite, a propellant; its use reduces the life of the firearm's barrel.
b. Dynamite.
c. Gelignite.
d. Gelatin.
e. Plastic Gelatin.

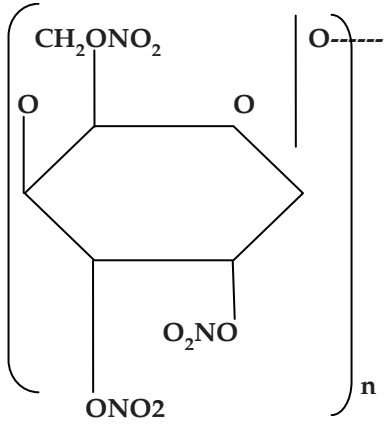
Modified nitroglycerin explosives are sold under a host of other trade names.

Nitroglycerin is a medicine also for heart and Angina Pectoris patients. It relieves the pain by reducing the blood pressure.

Nitroglycerin, when heated with sulphuric acid and mercury, gives nitrogen dioxide – a brown gas with a pungent odour.

Thin layer chromatography (TLC), using silica plate with ether solvent, is used to confirm nitroglycerin. Sodium hydroxide spray followed by the spray of Greiss agent gives yellow to red colour spots.

4.3 Nitrocellulose (Tri-nitrate)



Nitrocellulose, also known as gun cotton, is prepared from cotton or other cellulose by nitration. It has found extensive use in the manufacture of ammunition singly or in combination with nitroglycerin. As the latter has a tendency to corrode and damage the firearms, nitrocellulose is used alone in many propellant formulations.

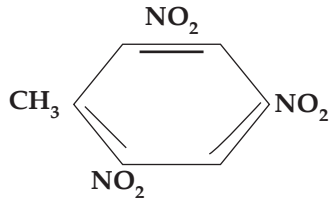
The maximum theoretical intake of nitrogen (in nitrate form) is 14.5%. However, explosive nitrocellulose contains slightly less than 13% nitrogen.

Nitrocellulose with less quantities of nitrogen (~ 11%) is used for making films, varnishes, lacquers, etc.

Explosive nitrocellulose behaves both like a high or low explosive. When the quantities are large or it is exploded in a confined place, it detonates. In open spaces and when the amount of the nitrocellulose is not large, it burns.

Nitrocellulose is identified through its solubility. It is insoluble in water, sparingly soluble in alcohol and soluble in acetone and certain esters. It is identified through TLC. The plate is coated with silica gel and acetone is used as solvent. Water elutes the nitrocellulose. Sodium hydroxide spray followed by Greiss Reagent gives red spots.

4.4 Trinitrotoluene (TNT)



Trinitrotoluene is a high explosive. It is obtained by the nitration of toluene - a product obtained from coal tar or from petroleum. It forms the major part of the bursting charge in many military explosives or explosive devices, either singly or in combinations with other explosives. Some of its combinations are:

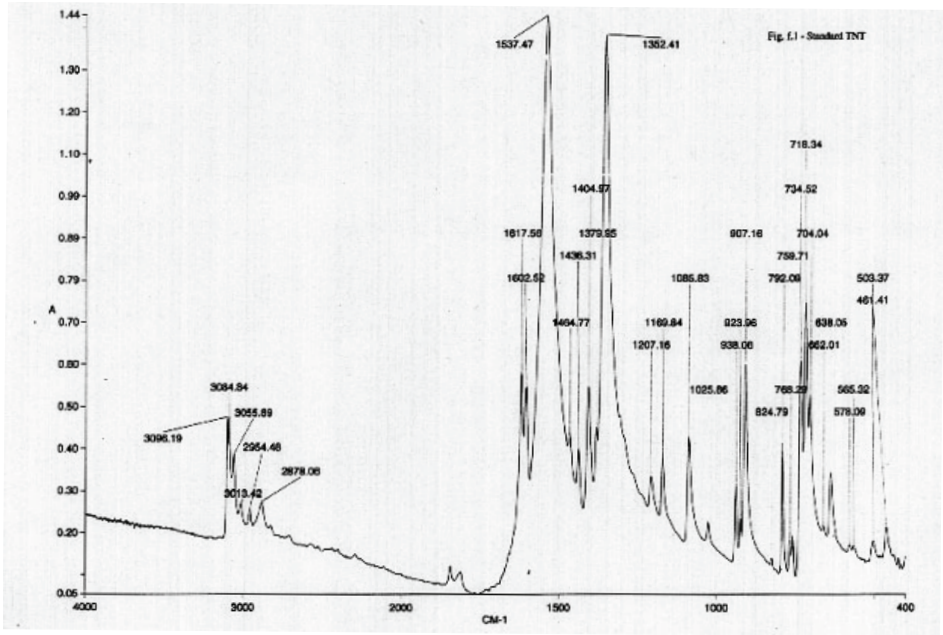


Fig. XXIII-4

TNT IR spectrum

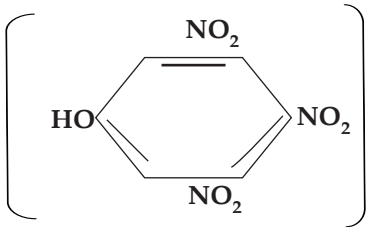
a. **Amonal—**it is a mixture of TNT, ammonium nitrate, aluminum and carbon.

b. **Amatal –** It is a mixture of TNT and Ammonium Nitrate.

TNT is identified from its light brown colour. On identification, other substances, both explosive and non-explosive, indicate the formulation of the explosive mixture. TLC, with ether as solvent and silica gel as TLC plate coating (stationary phase).is used to identify the explosive.

4.5 Picric Acid and Picrates

Picric Acid



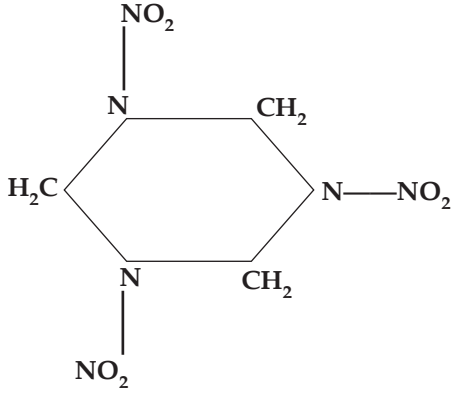
Picric acid is obtained by nitration of phenol. It is yellow in colour. Its solution is used as a tincture. Picrates are derivatives of picric acid. The acid is stored under water.

Picric acid and picrates are frequently encountered in homemade bombs. The explosions' products leave characteristic yellow stains on the objects around.

Picric acid and picrates are identified from their colour, melting points and derivatives with characteristic melting points.

Picric acid and other explosives can be identified and estimated by instrumental methods. TLC, IR, HPLC, XRD are particularly useful.

4.6 RDX (Research Department Explosive)



RDX or cyclonite is cyclo-1, 3, 5-trimethylene-2,4,6-trinitramine. It is one of the most important military explosives today. It is a highly stable high explosive. It is susceptible to shock.

RDX is used as a component of many formulations with TNT and PETN. Semtex is a plastic explosive created from RDX and PETN. RDX in its various avatars has been used as military explosive now for a long time. Its abuse by the terrorists is comparatively recent, especially since rogue governments have started supplying it to their favourite terrorist groups. It has become popular with the terrorists. They are now using it routinely on a large scale.

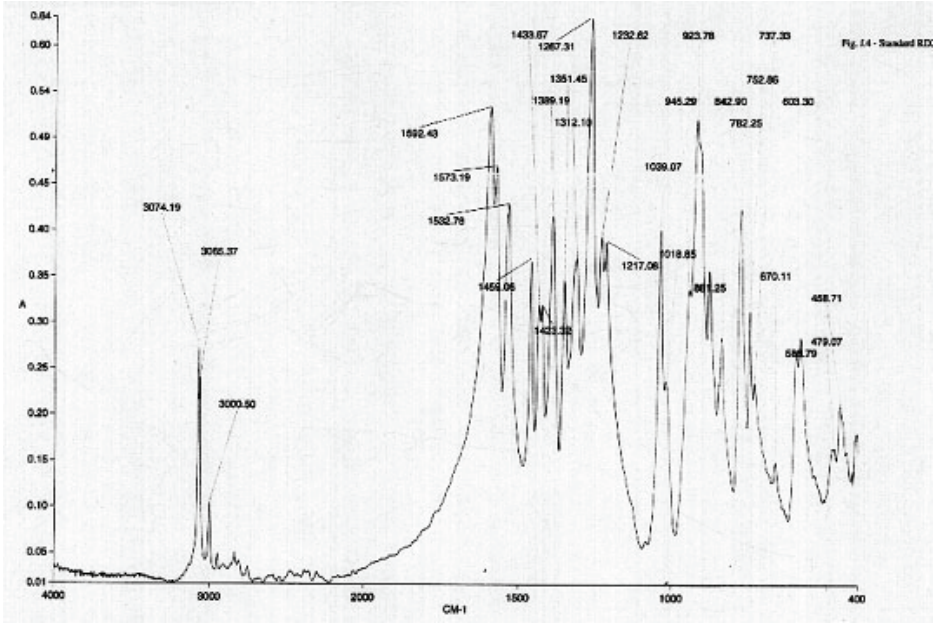


Fig. XXIII-5

RDX IR spectrum

RDX is identified easily:

a. Spot test: 6-Amino-1- naphthol, sulphuric acid gives yellow colour. Addition of ethanol changes it to blue, and then blue to grey.

b. TLC: Acetone and silica gel are used as the mobile and stationary phases.

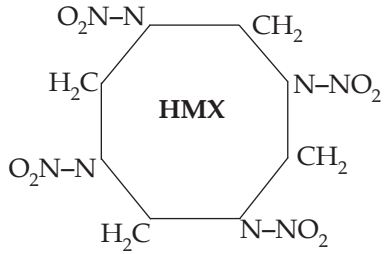
c. IR spectroscopy identifies RDX. Its acetone solution or potassium bromide pellet (FTIR) gives characteristic spectrum.

d. X-ray diffraction, GC-HPLC, GC-MS are the other techniques used for its identification.

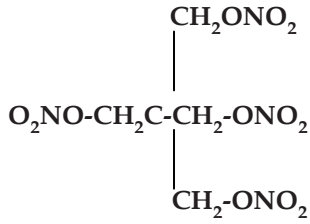
4.7 HMX

HMX is similar to RDX. Chemically it is *tetra*-methylene *tetra*-nitramine. The explosive is used as rocket fuel and as a booster charge in artillery shells.

Its identification follows the RDX pattern: Spot test, TLC, IR and XRD are the method of choice. GC, HPLC and GC-MS techniques have also been used.



4.8 PETN ($C_5H_8N_4O_{12}$)



PETN

PETN is chemically *penta*-erythritol *tetra*-nitrate. It is a basic explosive charge for blasting caps and detonators. It is also used as an ingredient of booster charges, plastic explosives and detonating cord. It is also used in place of nitroglycerine for angina pectoris though mono-nitrate of glycerin is replacing the two.

PETN is highly stable. It is, however, highly sensitive to impact.

The methods of choice are infrared spectroscopy or X-ray diffraction.

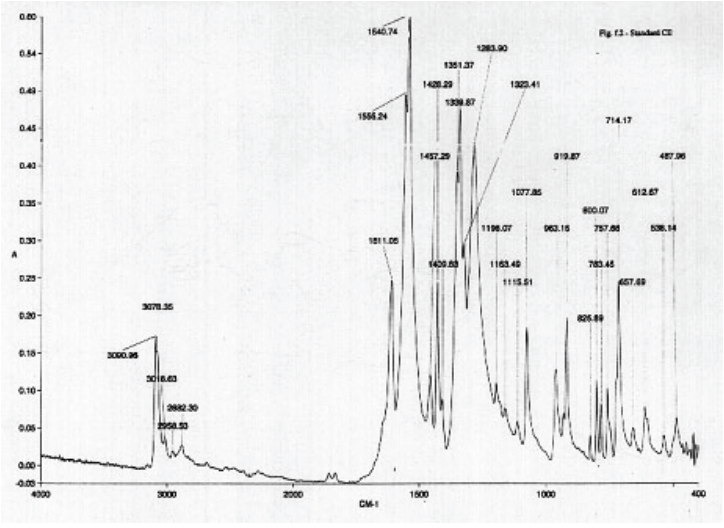


Fig. XXIII-6

PETN IR spectrum

4.9 Ammonium Nitrate (AN)

The main use of ammonium nitrate is as a fertilizer. However, it is an important component of many explosive formulations, especially in dynamites used for blasting purposes.

Ammonium nitrate is highly stable. It has low sensitivity to friction and impact. It is an explosive of choice for industrial purposes. It is a good oxidizer, provided the other components of the mixture do not react and change its characteristics. It is highly hygroscopic.

Ammonium nitrate alone can explode, if heated in airtight containers.

Ammonium nitrate is easily identified from the characteristic reaction of its ions.

4.10 Fulminates

Fulminates are high explosives. The fulminates are highly sensitive to friction and impact. Consequently, they are very dangerous to handle.

Fulminate of mercury [$Hg(ONC)_2$] is used as an initiator in many explosive devices, firearm ammunition and in other primers.

4.11 Lead or Silver Azide

Lead and silver azides are high explosives. They are sensitive to pressure. Lead azide [$Pb(N_3)_2$] is used in percussion caps and other primers to initiate the main charge. The substance is not used as an explosive as such.

Lead and silver azides are comparatively more stable to heat and storage and less sensitive to impact than fulminates. The compounds are used in many primer compositions. They are compatible with most of the explosives.

Silver azide (AgN_3) is more sensitive than lead azide.

4.12 Lead Styphnate ($C_6HN_3O_8Pb$) H_2O

Lead styphnate is used as a primer in initiator compositions in various explosive devices and in percussion caps of firearm ammunition.

The explosive properties of styphnate are similar to those of lead azide or fulminates. Lead styphnate is non-hygroscopic and non-corrosive. It is, however, very sensitive to electric or direct heating.

4.13 Tetracene (Tetrazene) $C_2H_6N_{10}$ (H_2O)

Tetracene is a highly sensitive explosive. It is stable to heat up to 75^0 C. It is used to sensitize primer compositions.

4.14 Dinol (DDNP) $C_6H_2N_4O_5$

The chemical name of dinol is Diazo di-nitro phenol. The compound is less sensitive to impact, friction and electrostatic charge as compared to other primary explosives. It is the primer charge of choice for industrial explosives, blasting, caps, etc.

4.15 Dynamites

Dynamites are frequently used illegally. The culprit procures them culprits from construction projects contractors.

The dynamites have different compositions, which help to identify the source of the dynamites. The usual tests (TLC, IR, GC and HPLC) are used to identify the organic constituents.

The constituents, which are used to manufacture the dynamites, are:

1. Nitroglycerine.
2. Nitrocellulose.
3. Ammonium Nitrate.
4. Sodium Nitrate.
5. Sulphur.
6. Filler, which may be saw dust.
7. Oils.

5. EXPLOSIVES DEVICES

There are too many explosives devices to permit any worthwhile discussion. It is therefore proposed to discuss here only those devices, which are sometimes involved with the criminal justice system.

5.1 Safety Fuses

Safety fuse is a train of black powder, like the lead of a pencil, enclosed and covered with cotton or jute threads or tape. There are ordinarily three layers of covering, but the number of layers and type of material used vary with different manufacturers. The outer layer is impregnated with moisture proof material varying from wax or coal tar to modern plastics. The powder is also enclosed in a rubber or plastic hose.

The burning speed of a safety fuse is controlled by the nature, grain structure, quantity and packing of the black powder. Usually it takes about seven seconds for the impulse to travel through one metre of a safety fuse.

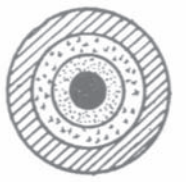


Fig. XXIII-7

Cross-sectional view

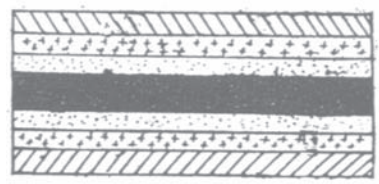


Fig. XXIII-8

Longitudinal sectional view of a safety fuse

5.2 Detonating Cord

Detonating cord is also called Fuse Cord. It has a somewhat similar function and structure to that of a safety fuse. However, the materials used are different. PETN replaces the black powder and plastic hose covers the explosive. It is used to connect and initiate a number of explosive devices and charges simultaneously. It is also used in non-electrical detonators. It is shockproof.

PETN is a high explosive. It detonates at a high speed of about 5000 m/s. It produces burn marks on the surfaces where it was placed. The marks remain

identifiable for a long time. They indicate the placement site of the detonating cord, to cause the explosion.

5.3 Primers

Primers are essential initiating devices used in small arms and artillery ammunition. The initiating charge in the primers of small arm consists of:

a. A sensitive primary explosive: Mercury fulminate, lead azide, or lead styphnate; the last being the favourite,
b. An oxidizing agent (potassium chlorate), and
c. A combustible material (antimony sulphide).

The initiating charge is placed in a percussion cap. Waterproof lacquer covers the charge in small arm ammunition.

The artillery primers are bigger in size. In addition to the initiating charge, they contain black powder to boost the initiation of the main explosive charge.

5.4 Military Detonators

Military detonators initiate and explode larger charges. Ordinarily, a detonator consists of a metal tube closed at one end. It is about 25 mm (one inch) in length and about 6 mm (a quarter of an inch) in diameter. The detonating charge is placed first in the tube and covered by primary explosive. A high explosive (tetryl) tops the two. Military detonators are also known as blasting caps.

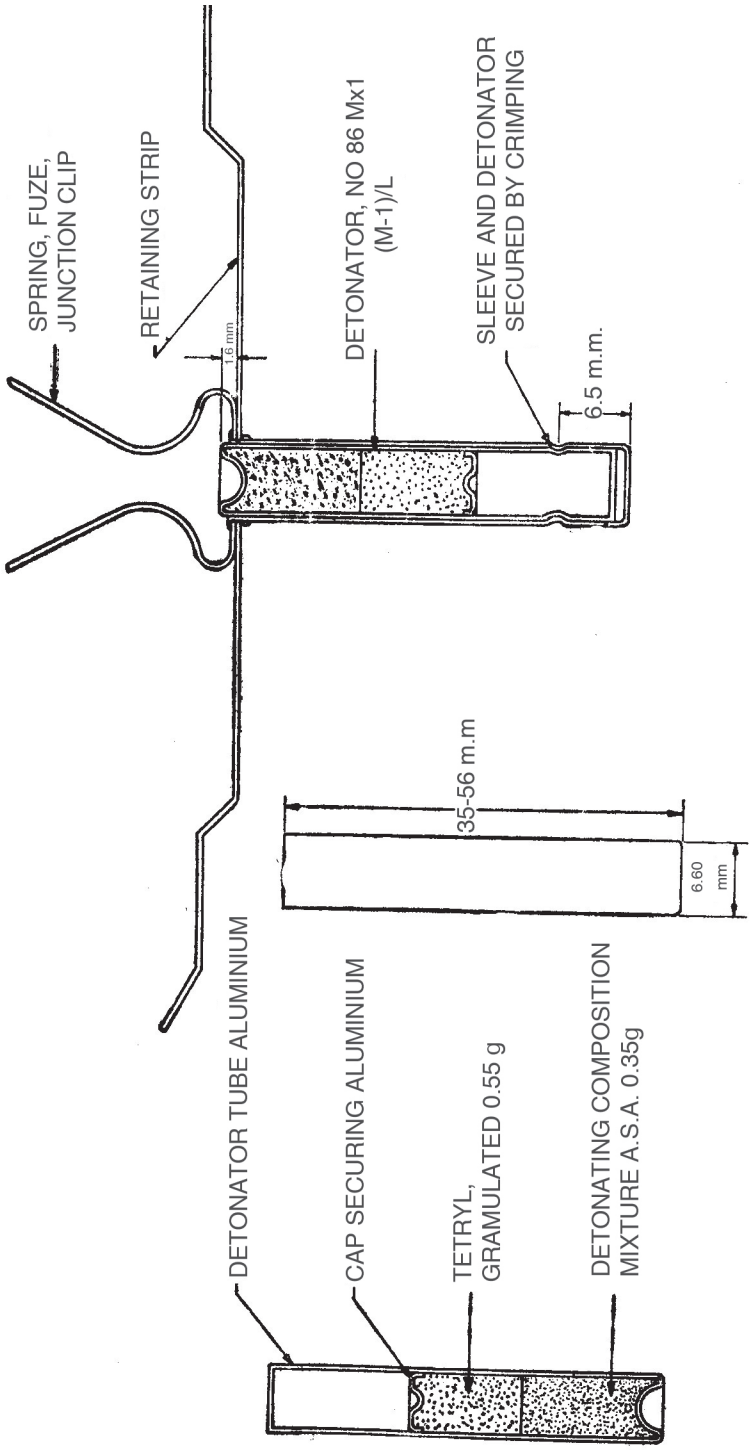


Fig. XXIII-9
Disruptive Detonators

5.5 Commercial detonators

Commercial detonators are also known as blasting caps. They are similar to the military detonators with the following components:

a. The **initiating charge** is usually lead azide.

b. The **detonating** charge is usually PETN.

c. M**etallic container** is made from aluminum, brass or copper. The detonating cord or electric lead wires are crimped into the container with a pair of pliers.

d. The **Initiating device** is a small electrical heating element placed in the detonator tube in the initiating charge and the two ends are connected to lead wires. On switching, the current heats the filament. It ignites the initiating charge, which in turn detonates the main charge.

Alternatively, a fuse cord is placed in the initiating charge. The other end of the cord is set on fire. It ignites the initiating charge, which in turn detonates the bursting charge.

In the explosion, the blasting cap gets shattered. Bits of the container tube and the marks of the burnt fuse are found in the debris on careful search.

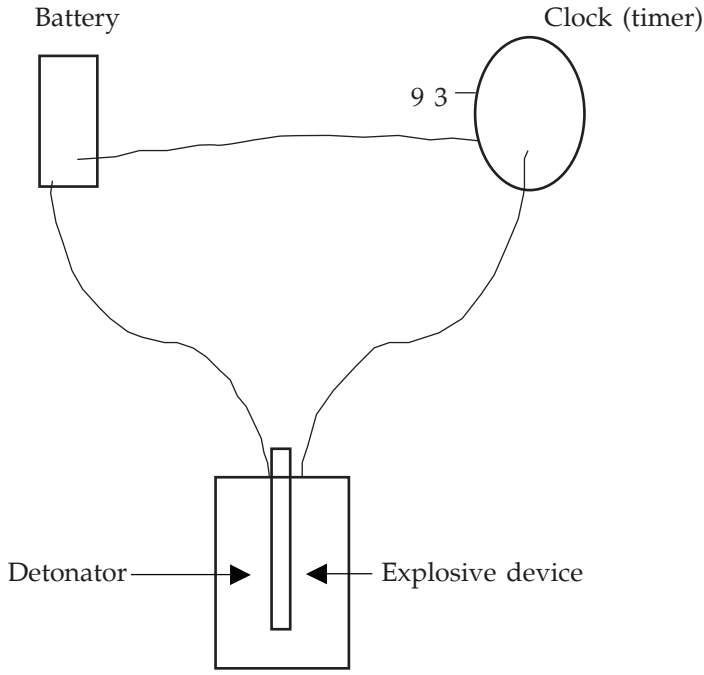


Fig. XXIII-10
Delayed Explosion setup

5.6 Explosive Train

An explosive train is an arrangement of different explosives of varying sensitivity and power to achieve proper initiation and detonation of the main charge to achieve maximal explosive effect of the given explosive with maximum safety.

The train has essentially three parts:

a. The firing device.

b. The detonator and the booster charge.

c. The main bursting charge contained in a shell of specific design.

The arrangements, however, vary tremendously in accordance with the nature of the explosive device.

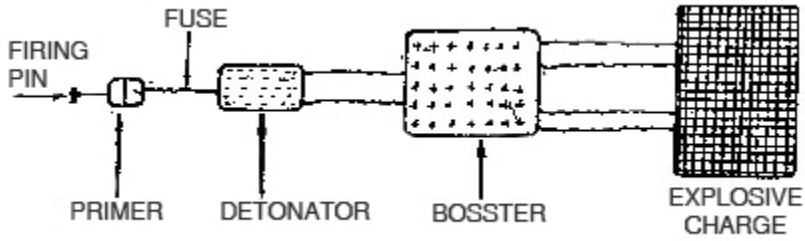


Fig. XXIII-11

Explosive Train Arrangement in High Power Bombs and other Explosive Devices.

5.7 Grenade

A grenade has an explosive charge, an initiating charge, and an initiation device, all contained within a case. On explosion, it shatters into pieces, which act as missiles. They injure persons around the area (of about 20 m radius) where the grenade bursts.

The initiating device is a primer cap. The trigger is in the form of a lever, which is held along the case with a pin. When the grenade is to be used, the lever is released. It is actuated by a spring. The lever flies upward and the hammer thereon strikes the cap. The primer mixture gives out flame, which ignites a safety fuse, kept in the cap. The other end of the fuse initiates a detonator kept in the main explosive charge (usually TNT or Baratol). The charge explodes and bursts the grenade. The safety fuse has a specific length to delay the explosion. Usually two lengths are used. One delays the explosion by about 4 seconds and the other by 7 seconds. A grenade can be thrown to a range of about twenty metres. It is dangerous in an area of a circle of about the same radius (20 metres).

The complete initiating device is one separate piece, kept separately, away from the grenade during storage. The grenade is safe if the initiating device is not fitted in the body of the grenade.

The initiating device is screwed to the main structure with the base plug, to keep it in position. The grenade is ready for use.

The grenade body contains the explosive charge.

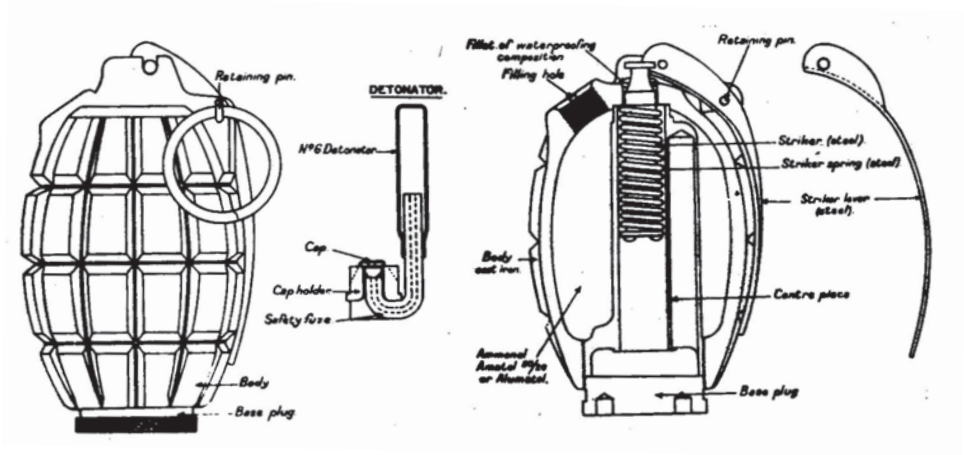


Fig. XXIII-12
Sketch of a Grenade. The Various Parts are Indicated in the Figure.

5.8 Military Bombs and Shells

The variety of military bombs and shells is very large. It is increasing every year. They are made to rigid military specifications. In general, they are structured on the basic principle of the explosive train. Excluding hand grenades, and mines, military explosive devices, are rarely encountered in police work. They are easily distinguished from homemade bombs (IEDs) through the following elements:

a. All military bombs have a good finish.
b. They bear identification marks: make, year of manufacture, etc. The marks may be letters, figures or monograms on various parts of the device.
c. They have an appreciable size, except for the anti personnel mines and detonators.

6. IMPROVISED EXPLOSIVE DEVICES

There is an infinite variety of crude Improvised Explosive Devices (IEDs). They do not conform to any pattern or design. In fact, the nature of the contraption depends upon the ingenuity of the culprit and on the availability of materials, which form components of the device.

The essential components of an IED are:

a. A container.
b. An explosive.
c. An initiation device.
d. Missiles.

6.1 Containers

The containers of IEDs are extremely varied. Strings, paper, cloth, bottles, bulbs, tins, torch covers, bamboo poles, coconut shells, earthen pots and pipes have been used. They are used, usually, for bombs of small size, weighing less than a kilogram. The terrorists have promoted new names for IED bombs:

1. **Transistor Bombs**

   In these bombs, the casing of a transistor radio and its electrical circuits and switches are used as essential components. These bombs are left at busy places, supposedly by some careless owner, When a person picks it up and fiddles with it, the explosive inside explodes and kills the handler and other person who happen to be nearby.

2. **Suitcase Bombs**

   In suitcase bombs, suitcases form the casing of the bomb. They house the explosives and the initiating and timing devices. They are left at or in the intended targets like cars, buses, trains, aeroplanes, buildings, etc. The infernal device explodes at the set time and takes a toll of life and property. In the meanwhile, the terrorists have had ample time to vanish from the scene. The power of these time bombs has varied, depending on the maker's ingenuity.

3. **Human Bomb**

   Human bombs are also called suicide bombers. In Pakistan, they are also called *Fidayeen*. They were initially used to kill important leaders. They are now being used for all sorts of destruction. A spate of suicide bombings and armed attacks by Pakistanis have caused a lot of death and destruction in India also. The glaring examples are Parliament attack in 2001, Taj hotel Mumbai attack in 2008, Gurdaspur security breach in 2015, at Pathankot in 2016, etc.

6.2 Explosives

The explosive is the most important constituent of an IED. It may be any of the following substances:

1. Military or commercial explosives.
2. Small-arms propellants.
3. Nitrate mixtures. Nitrates of ammonia, barium, potassium have been used for the purpose in combination with other ingredients.
4. Chlorate mixtures[1]; they are used in the same way as nitrate mixtures, often with more disastrous results. The mixtures are also used as initiators for other explosives devices (IEDs).
5. The highly inflammable organic liquids have excellent explosive properties. The famous (or infamous) Molotov cocktails only contain petrol. The explosion, in 2001, of the World Trade Towers, New York, was achieved by aviation turbine fuel in the commercial aeroplanes.

6.3 Initiation Devices

The initiation devices on IEDs vary tremendously. The common ones are:

1. **Mechanical:** fall, crushing, impact, friction.
2. **Shock**: induced by other explosions.

1. For example, a mixture of potassium chlorate and sugar catches fire immediately on coming into contact with sulphuric acid.

3. **Heat**: flame, steam, exhaust pipe emissions.
4. **Spark:** flame, cinders.
5. **Chemicals:** for example, sugar-chlorate-sulphuric acid mixture.
6. **Miscellaneous:** light, infra red rays, laser, ultrasound waves, electric current.

6.4 Missiles

All sort of materials including stone pieces, ball bearing, nails cut pieces of wires or the exploded pieces of containers have formed missiles in IEDs.

Fig. XXIII-13

Nail as missiles found in an IED

6.5 Novel Initiation Modes

1. **Radio waves**. They may actuate an electric circuit, which starts the explosion.
2. **Trip wire.** A wire may be arranged in such a way that if it is tripped upon, it makes or breaks an electrical circuit to actuate the initiating mechanism.
3. **Remote control.** Remote control devices are being used to initiate explosive devices. They function on the same principles as a remote control device in the television set, to complete an electrical circuit and initiate the infernal device.

4. **Capsule initiation**. A capsule filled with sulphuric acid is kept in a sugar chlorate mixture. On the corrosion of the capsule, the acid mixes with the mixture and starts fire, which, in turn, initiates the explosive device.
5. **Miscellaneous**. The improvised initiation device may include an anti-handling mechanism. As soon as the device is handled, it explodes. The handling may actuate chemical mixing, mechanical spring or an electrical switch and starts the explosion. The variety of mechanical devices is legion and unlimited.

Other types of initiators utilise photoelectric devices, sound operating switches, changes in temperature and moisture. Remote controlled electronic devices have become common with the hi-tech terrorist. The devices are available which can initiate explosion even from kilometers. IR sensors, as used in electronic timers, are quite popular for short-range initiations. The trip wires have also been used to blow up vehicles on the road, in parking places or on railways tracks. An ordinary mobile phone was used to initiate the Bali nightclub explosions, which killed a large number of tourists.

6.7 Improvised Devices

The following are the common types of IEDs, encountered in police work.

1. Throw-downs

Throw-down bombs are used frequently in India. They work on the same principle on which a similar throw-down cracker works. On throwing down the bomb, the impact force initiates/explode the sensitive material kept inside. Suitable chlorate mixture, fulminates mixtures, other chemical mixtures have been used to start the explosion.

Throw-down bombs are often balls of various sizes; the smallest effective bomb being over 5 cm in diameter.

2. Fuse Bombs

Fuse bombs are fitted with a safety fuse. The fuse is ignited before using the bomb. The fuse cord of convenient length is used so that it does not explode while being thrown. The lighted fuse puts the explosive charge on fire and the device explodes. This is the easiest and safest arrangement for initiation.

3. Percussion Cap Bombs

In percussion cap bombs, the initiation of the charge is similar to that of a grenade. A mechanical arrangement is made to hit a percussion cap. The exploded percussion cap puts the explosive charge on fire. Some terrorists of Punjab, in the 1980s, sometimes used this mode to initiate IEDs. They used percussion caps of standard ammunition along with a nail/hammer arrangement.

4. Time Bombs

Time bombs explode at a preset time. Clocks or watches are usually used to fix the time of explosion. Other modes like electronic timers also used.

A time bomb using a clock to fix the time of the explosion is included in an electric circuit along with the initiator and a battery. One end of the wire of the

circuit is connected to the metallic needle of the watch (usually the hour hand) and the other end at the hour digit (or site). When the hour hand touches the digit or the site, the electric circuit is completed. It activates/initiates/explodes the explosive system. Suitcase bombs were usually time bomb.

A clock mechanism is the most accurate method of timing a bomb and can serve to start an explosion at any time within 12 hours. New electronic timers can fix the time of explosion even up to 18 months or more.

Other types of timing devices have also been used:

1. The alarm system of a clock can start an explosion if a primary explosive is placed on the gong where the hammer strikes.
2. Corrosion of a metal or plastic container and seepage of sulphuric acid into a sugar-chlorate mixture can initiate an explosion. Estimate of corrosion time can be used for timing the explosion. Alternatively, when a container is fully corroded, an electrical connection is made which starts the explosion.
3. A capsule filled with sulphuric acid is placed in a sugar-chlorate mixture. The acid corrodes the capsule walls, which trickles down and initiates the explosion.
4. Fuse cords have also been utilized for timing the explosion. However, the fuse cord gives a limited timing interval, only long enough to run away to a safe place. The rate of a slow burning safety fuse is about 70 cm/minute. Therefore, seven meters of burning fuse cord will give ten minutes.
5. Natural fibre strings have also been employed. A greater delay can be obtained with this arrangement. However, smoke and burning smell can give away the device. Besides, rain and wind can also upset the arrangement.

In an interesting case, a man was sleeping in his ground floor bedroom. The window of the room was open. His foe found it an excellent opportunity to kill him. He took dynamite sticks, fixed a string in the sticks and placed the sticks through the window, close to his head. He lighted the other end of the string and ran away from the site. The intended victim, however, smelt something burning. He got up with a start and saw the string burning. He pulled out the smouldering string and threw it out. Only then did he notice the dynamite. The smouldering fire had reached quite close to the sticks. (CH)

5. Letter Bombs

In 1972, there was an international wave of letter bombs. The wave caused not only death and injuries to a large number of persons; worse still, it caused panic in the world. Fortunately the wave has since subsided. However, the letter bomb is a novelty, which does pester people, now and then.

A letter bomb is a booby trap. It has to pass as a letter or a postal packet. Consequently, it must have limited dimensions and weight. Yet the device must contain all the components of a booby trap: a container, an explosive, missiles and an initiation device.

The container is the letter or packet cover. As the package has to move through the postal process, it has to be safe through transit. The container and the contents, therefore, have to be carefully selected, arranged and packed.

It has been estimated that about fifty grams of high explosives is sufficient to kill or injure a person seriously from a distance of about fifty centimeters. When a person is handling a letter bomb, the distance is often less. Consequently, the quantity of fifty grams of the needed explosive can be placed in a letter bomb. It does not make the letter or packet too bulky or suspicious, especially if the explosive is placed in the form of a sheet cut to the size of the letter cover.

The main ingenuity of the culprit lies in the choice and arrangement of an initiation device. A host of modes has been used:

1. The explosive chosen is so sensitive that it explodes on rough handling.
2. A friction sensitive explosive is placed at possible tearing sites for opening the letter. The tearing process explodes the letter bomb.
3. Potassium chlorate mixtures are placed in such a position that they, at the time of opening, start the explosion.
4. A miniature percussion cap (or detonator) and spring operated hammer is placed in the postal parcel in such a way that the hammer, on opening the packet, strikes the cap and explodes the explosive.
5. On opening the letter or packet bomb, a tiny battery gives a spark and initiates the charge.

The world is so much used to postal letters and packets that nobody cares to note the address or think about the possibility of its being an infernal device. The following observations help to identify a letter/packet bomb:

1. A letter bomb often does not bear the address of the sender. It is frequently unregistered and may be over stamped. It is often marked 'personal' 'confidential' or 'secret'.
2. The letter bomb cover may carry stains.
3. The letter or packet bomb may be oddly uneven. It happens when an electrical or mechanical device to initiate the explosion is used. Metallic objects, wire or spring can be felt or seen inside the packet.
4. The letter or packet bomb may have a cardboard-like stiff material inside, but is heavier than a normal piece of cardboard.
5. The name and other words on the letter bomb may have been misspelled or written in capitals.
6. The letter bomb may give smell of oil or perfume.

The above aspects of a letter are checked systematically:

1. Suspect all letters or parcels from unknown sources.
2. Do not open a letter or a packet until found to be safe.
3. Get expert help to handle a suspicious packet or parcel.

4. Scrutinise the letter visually and feel the contents manually for any incongruity. Presence of a rattling noise inside is odd. Ascertain the cause before opening the letter.
5. Examine the letter or packet in transmitted light using a strong yet cool source of light (the light rays filtered through special glass). It may indicate abnormal objects. Ascertain their nature before opening the letter or packet.
6. Observe the letter under ultraviolet light. It may reveal unusual suspicious spots on the letter or packet.
7. Get the packet checked with infrared rays. They reveal the content of the letters. Most of the Forensic Science Laboratories now have infrared image conversion devices. The nature of the contents of packet (letter) can thus be evaluated without opening the letter or package.
8. Get the packet X-rayed. They reveal radio opaque objects. Thus, if a letter bomb is examined (screened as at airports) the initiation device is revealed in most of the cases. X-ray equipment is available in most of the hospital in addition to the Forensic Science Laboratories. Soft X-rays are used.
9. Take the suspected letter bomb to an open space. Place it in a pit of about one metre diameter and depth. Handle it roughly (shake, turn, beat and press) by a remote controlled device. A strong long staff is efficient enough in most of the cases. Give sufficient time for each process. The device will explode, if it is designed to explode.

If the above checks and rough handling fail to reveal the infernal nature of the letter bomb, open the letter cautiously. The guiding principle in opening a suspect letter is to cover about 90-95% of its surface with a heavy book. All the edges are cut opened with a thin wooden (bamboo) strip in turn. The contents are taken out employing minimal force to cut or separate the edges. The opening is done cautiously and slowly. Haste can cause explosion.

6. Transistor Bombs

Terrorists have used transistor bombs. The terrorists would leave such bombs in Public places where someone would pick them up and fiddle with them. The bomb would explode killing the fiddlers and nearby persons.

In transistor bombs, the cover of the transistor houses the explosive and the missiles. The electrical system, including off-on switch, serves to initiate the bomb electrically.

7. Magnetic Bombs

Magnetic bombs are usual time bombs having a moderately powerful magnet attached to the device. The magnet helps to fix the bomb to the car of the victims. The bomb would explode at the prefixed time, blowing the car to pieces and killing the persons in the car and bystanders.

Fig. XXIII-14

Human Bomb belt filled with explosive and detonating device

8. Human Bombs

The human bomb contains adequate amount of high explosive and an initiating device. The shorter version of the bomb is the form of a belt, worn under the normal clothing. It is tied around the waist of the human bomb, a person who has been frightened/hypnotized/indoctrinated/tricked/purchased to sacrifice his life. When he approaches the victim, the handler initiates the device, usually through a remote control.

> *Ex-prime minister Rajiv Gandhi, and later Punjab Chief Minister S. Beant Singh, were assassinated by human bombs. The woman who assassinated Rajiv Gandhi herself initiated the bomb. In the CM case, perhaps the bomb was initiated through a remote control. (CH)*

Taliban in Pakistan has refined the abuse of human bombs extensively. The use of explosive-laden motor vehicles (motor cycles, cars and trucks) by the human bombs has increased their lethality. They barge into buildings, installations and crowds carrying huge amounts of explosive and cause tremendous losses of life and property.

7. FIREWORKS (PYROTECHNICS)

Fireworks or pyrotechnics are also known as crackers. They are substances, which produce, through chemical changes and on self-sustained basis, heat, light, sound, smoke or a combination of them, on initiation.

The fireworks are made at licensed premises only. The factories are located outside the main centres of activity in a city. Fireworks are made from a host of materials, specified and approved by the authorities. They, however, do not contain any chlorate in their composition.

The main explosive ingredient of crackers is black powder. Barium nitrate has also been employed in firework compositions. The chlorates are prohibited, as they are dangerous. However, some use them illegally in some compositions. Most of the throw-downs crackers (or homemade bombs) contain potassium chlorate.

The initiation device in crackers, ordinarily, consists of a paper tube containing mainly black powder, as in a safety fuse. The paper tube is partly exposed and partly embedded in the crackers' explosive material inside. The outer portion is lighted; the black powder in the tubes carries the fire inside the cracker and explodes the charge therein. Other initiation devices include impact initiation (as in throw-downs) or friction initiation.

There is a large variety of crackers. They differ from other explosive devices in many ways. One important difference is that the crackers (and fireworks) in addition to noise, give spark and lights. In some, beautiful multi-coloured display of lights is achieved mainly using aluminum, magnesium and barium metals or their salts.

Cracker manufacturers sometimes ignore regulations and make crackers, which have a larger size, and consequently, are more dangerous.

8. NON-EXPLOSIVE EXPLOSIVE MIXTURE

Non-explosive explosions are those where the usual known explosives do not form the explosive charge. Instead, ordinary substances under certain conditions explode and cause havoc. They may be:

1. **Mechanical Explosion.—**Here the compressed gases, air or vapours suddenly break loose and cause the explosion. Bursting of gas cylinders or boilers are some such explosions.
2. **Thermal explosion.—**When volatile liquids come in contact with surfaces at very high temperature, sudden conversion of liquid to vapours takes place, causing the explosion.
3. **Aerosol Explosions.—**Aerosol or diffused explosion are caused by natural gas, fuel gas, other inflammable gases and vapours of volatile liquids (petroleum products, alcohol, ethers etc.) When the concentrations of gas or vapours in the air cross certain limits in a confined place, such as a room, the mixture becomes explosive. A spark, flame or heat explodes the mixture to cause explosion.

Strictly speaking, these explosions are cases of rapid burning. However, due to the large volume of gases created in confined spaces they cause explosion. They blow out the walls, break the doors and windows, bend steel bars and even move and crack concrete roof slabs. The explosive force of these aerosols is maximum when the concentration of the gas in air reaches the theoretical value for its complete combustion.

If the amount of inflammables is less than the minimum critical concentration, there will be no explosion. If the mixture contains a greater amount of the inflammable vapour or gas than the ideal concentration, the burning is slower. It is sustained for a longer time, however. The explosion may also start secondary fires. If, however, the concentrations go beyond the maximum critical limits, again there is no explosion.

Organic dust like flour, maize husk, sawdust, coal or charcoal dust sometimes dispersed in air in confined places form explosive mixtures. They explode on receiving a spark or flame.

In a pharmaceutical factory in a town of Madhya Pradesh, the formulations of medicinal tablets contained starch as the major constituent by weight. Inappropriate humidity control dispersed the starch in the atmosphere of the hall where the tablets were being manufactured. An uneducated labourer struck a matchstick to light a bidi. There was a big explosion, which shattered the doors and windows of the hall and killed the labourer, the only person in the hall at that time. **(CH)**

TABLE XXIII-8

Non-Explosive Explosion Mixtures

S. No.	Material	State	Ignition Temp°C	Complete burning (Required %)	Minimum Concen-tration:%	MAX concent-ration (%)
1	Acetylene	Gas	305	2.5	2.15	80
2	Ethyl Alcohol	Liquid	392	3.3	3.3	19
3	Ammonia	Gas	—	—	16	25
4	Benzene	Liquid	580	1. 4	1.4	8.0
5	Butane	Gas	—	—	1.9	8.5
6	Carbon monoxide	Gas	609	12. 5	12.0	75
7	Coal Gas	Gas		5.3	4.5	40
8	Ethane	Gas	472	3.3	3.0	16
9	Diethyl Ether	Liquid	165	3.3	—	—
10	Ethylene)	Gas	—	—	2.7	34
11	Petrol	Liquid	280	1.3	1.3	7.6
12	Hydrogen	Gas	574	4.2	4.0	75
13	Kerosene	Liquid	255	1.2	1.0	8.0
14	LPG	Gas	—	—	2.0	10
15	Methane	Gas	632	5.3	5.0	16
16	Natural gas	Gas	—	4.8	2.2	9.6
17	Naptha	Liquid	232-277	10	—	—
18	Octane	Liquid	230	.84	—	—
19	Propane	Liquid	—	—	2.	9.6
20	Turpentine	Liquid	240	.80	—	—

The critical lower and upper limits are different for different materials. The limits of some of the common explosive mixtures are given in the table above.

A few years ago, a can containing rectified spirit was being sealed with sealing wax after use. All of a sudden, the can exploded spreading the rectified spirit all around and started fire. The operator suffered serious burns.

The alcohol-and air mixture in the empty space of the can formed an explosive mixture and caused the explosion. (CH)

9. HANDLING LIVE EXPLOSIVES

The task of locating, handling and defusing explosive devices/explosives is an important function of the law enforcement agencies, all over the world. It is dangerous and time consuming. The explosive/explosive device may be hidden anywhere: on the person of the terrorist, in his luggage, on his vehicle or he may have placed, carried and distributed the explosives in an innocuous looking containers. Further, the terrorists smuggle, transport, hide and distribute the explosives and explosive devices covertly. They choose time and place to explode them to create maximum loss of life and properties and create widespread wide spread panic and fear. It keeps the keepers of law and order on tender hooks. Public places, buildings, aeroplanes, trains, etc., are the usual targets.

Law enforcement agencies have to prevent explosions. They can do so only if they preempt the bomber in his act. Intensive intelligence and eternal vigilance are the watchwords! Science can help them in a big way to assist to locate/identify/handle the explosives/explosive devices. They must exploit the available technology to keep ahead of the criminal.

9.1 Location/Detection

The terrorist, necessarily, conceal and camouflage the explosive devices to look like innocuous objects when he is transporting them or storing them at a place of his choice. They are discovered by searching the suspected places/ objects manually. Human search is often not effective and it is embarrassing in certain situations. Other modes have come up which assume the following presumptions:

1. The explosive devices have specific shapes and structures.
2. The texture of an explosive is different from the texture of other materials.
3. Explosives continuously emit micro-clusters of explosive molecules or their fragments, which defuse in the surrounding air and remain there.
4. Some of the micro clusters of the explosive molecules (or their fragments) are adsorbed by the surfaces close to the explosive/explosive device.
5. Some of the explosives are volatile. Vapours of such explosive are present in the surrounding air.
6. Most of the explosives disintegrate continuously. The disintegrated products escape into the surrounding air. Explosive detectors (instruments) and trained dogs can detect them.

The detection/locating techniques of the explosives, based upon the above concepts include:

1. X-ray Devices

X-ray machines have been in use for a long time to detect hidden objects, including explosive devices. They were particularly handy at airports to detect firearms/bombs in the baggage. Improvised explosive devices could also be recognized if they had a clock mechanism for initiating the IED; or, if they had

metallic missiles to kill persons. They were, however, ineffective to identify explosives *per se*.

The working of these machines was simple. X-rays were passed through the baggage and the X-rays created images (shadowgraphs) on the screen, which could be observed and the explosive devices identified by the operator.

2. Modified X-ray Machine

In the new machine, both hard and soft X-rays are used. Hard rays (higher energy rays) pass through materials of a higher atomic number, whereas soft X-rays (low energy rays) would not pass through such material; they will only pass through material of a low atomic number.

The device was useful, but did not solve the problem of identification of the explosive. It was further modified using a computer to process the data obtained by the dual (hard and soft) energy X-rays. Thus, computer appendage inducted automation. The instrument now gives signal when it suspects an explosive in the baggage. The new package is used widely at airports to check baggages.

The system is undergoing continuous improvements.

3. CT Scan

One is familiar with the CT (Computed Tomography) Scan used in medical diagnostics. It reveals, layer by layer, the internal make-up variations of an object. The differentiation of the contents is due to the density of the material and the atomic numbers of the constituents. The principle has been utilized to scan baggage, closed packets and parcels to detect explosives and explosive devices. Instruments have come up which are routinely being used for the purpose. The instrument can distinguish between explosive and other artefacts.

The instrument is somewhat slower than the dual energy system equipment. Maintenance is also costly.

X-ray systems, to check the baggage of the trains/buses/aeroplane passengers, are now routine. They have become indispensable. The systems are also employed to other targeting objects/paraphernalia of the terrorists, to prevent bomb attacks.

4. Thermal Neutron Activation (TNA)

Thermal neutron activation analysis appears to be an attractive technique as it determines the concentration of nitrogen atoms in a particular package. This concentration is about 15 to 35 % in various explosives. Non- explosive substances seldom contain this high percentage. Hence, a lot of research work is being done to utilize TNA for the bulk detection of explosives at airports and elsewhere.

The technique depends upon the fact that when thermal neutrons come in contact with a nitrogen atom the latter picks up a neutron and becomes radioactive, emitting Gamma rays.

$$^{14}N + n_{th} \longrightarrow {}^{15}N^* \longrightarrow \text{radiations}$$

The strength of the emitted radiation is a function of the concentration of the nitrogen atoms activated/present. Thus, they indicate whether the package

(or baggage) contain explosive or not and how much is the quantity of the explosive(s).

5. Trace Explosive Detection

Explosives leave their traces at all places where they are kept or moved. Traces of explosive are prominently found in the following places:

1. The manufacturing, assembling or dismantling sites.
2. The hiding, storage and disposal sites.
3. The explosion site.
4. On the hand/body/clothes of the handler (manufacturer, carrier, user (who explode) and the victim.
5. The carrier vehicle.
6. The containers, in which the explosive is kept.

Diffusion of vapours of the explosives or their disintegrated products in the surrounding air provides micro-clusters of explosive molecules or their parts at the site, which makes it possible to detect/identify them and to fix the locations of the explosives through these traces of the explosives. The explosive traces do not go very far from the main source because of high molecular weight. Recent developments in trace analysis technology have made it possible their detection.

Detection and identification of the traces is of great importance:

1. It identifies the hiding place of the explosive or explosive device.
2. It identifies the explosive, and its nature, which may indicate the terrorist group who placed the explosive at the site.
3. The device and/or its package may carry evidence that may link it to the culprit.

The detection of explosive traces of live explosives is the most important pre-emptive action to control terrorist bombings.

6. Detective Dogs

Dogs are a great gift to humanity. They are good companion, better security guards and the best detectives, especially for explosives/explosive devices. It is because nature has bestowed upon them:

(1) Extraordinary smelling powers; a rough guess of their smelling power is that it is more than 300 times than that of human beings.

(2) Excellent memory.

(3) Excellent sound sensitivity (hearing power), and

(4) Extraordinary visual powers.

The dogs surpass all other modes in efficiency, versatility and certainty for the detection of explosives. Experimental trials have shown that a properly trained dog, if properly handled, can locate traces of explosives in about 85% of the cases. The corresponding figures for human beings, are about 35%. The success-rate for instrumental detection of explosive traces was about 50%. The

instruments are being improved every day. Their efficiency may increase in the coming times but it is unlikely to surpass kennel efficiency. The dog is the best bet for locating traces of explosives.

There are certain basics to achieve the best result through dogs:

(1) The dog must receive adequate and proper training. Training must remain a continuous process, no stopping.

(2) The dog must be in good health. Sick dogs make mistakes. A bitch in heat will also not function efficiently.

(3) The dog tires in about two hours. If the period of search is extended, the results will not be reliable. After every 20 minutes of searching the dog should be rested.

(4) The dog is sluggish immediately after meals. It should be put on duty only after some interval (~ 2 Hrs.) after the meal.

(5) It is better to employ a pair of dogs for searching a scene. It is synergic.

(6) The handler of the dog should not be changed.

(7) The handler must be intelligent, a dog lover and properly trained to handle the dog. In fact, the handler requires longer training than the dog.

(8) The dog and the handler must get the training together.

The dogs vary in their utilitarian powers from one breed to another in different qualities, including intelligence. The German shepherd is considered the best as an all purpose police dog.

Some studies about the sensitivity and reliability of the dogs in detecting explosives were carried out in the USA in recent times. They found that there were hardly any false positives and the dog could recognize explosive traces when the concentrations were as low as 90 PPT (Parts Per Trillion).

7. Instrumental Detection

Instruments are widely used in the detection of explosive traces. Continued research over the decades in instrumental detection of explosive traces has brought in a number of devises that are proving their utility.

All instruments involved in handling explosive traces, essentially perform the following functions:

1. Collect the vapours from the site.
2. Concentrate the collected samples.
3. Identify its explosive nature.
4. Identify the particular explosive involved.

The first function of collection of the explosive traces is by suction. It may suck the air surrounding the hiding place of the explosive, it may suck the surface suspected to bear adsorbed explosive traces or it may suck the explosive traces from the wipe of the suspected surface.

In all situations, sucked traces are concentrated. It is done by passing on the traces to a filter or other special surface where they are deposited and readied for analysis.

Controlled heating is used to extract the explosive traces from the filter/surface used to absorb.

Gas chromatograph is used as analyser. It may use electron capture detector, chemiluminescence detector or Ion Mobility Spectrometry (IMS) or Mass spectrometry. The instrument (Explosive Vapour Detector) is programmed for automation. It works at high speed and gives results within seconds.

The reliability of these techniques was low in the initial stages but it is improving with the passage of time (research inputs!).

8. Explosives Markers

Petrol was being adulterated with kerosene some decades ago, mainly because the price of kerosene was subsidized. To counter this, the government began adding a dye to kerosene and thus controlled the adulteration somewhat. Likewise, if some detective tag chemical (radioisotope markers) were added to the explosives/explosives materials, it would help location/detection of the hidden explosives. However, the terrorists in India are using smuggled explosives in all major strikes.

9.2 Handling of Live Explosive/IEDs

Live explosive or explosive devices may be planted at the intended scene of explosion; or they are left accidentally/intentionally at the explosion site. Alternatively, they are recovered from other suspected sites on the basis of information receive from police sources. The live devices/explosives are collected at the earliest, to avoid their explosion and consequent loss of lives, limbs and/or property.

The main problem in handling live explosives/explosive devices is the danger it involves. It can be a time bomb and may explode at the time when the team is working on it. It is more so with IEDs. They require zero handling errors.

Only trained professionals (bomb-disposed squad) handle the live bombs/explosives. These squads were not common in India previously. However, due to the increased activities of the terrorists, most police forces have organized their own live-bomb disposal squads, both in their departmental laboratories and in their training institutes. The military bomb disposal squads also help.

The squad proceeds systematically to handle the situation:

1. The team evacuates the premises at the earliest, if not already done.
2. It considers the device dangerous, until proved otherwise.
3. It does not fiddle with the unknown devices. (IEDs are unknown devices!)
4. It documents the device/scene/discovery/recovery and other evidence (labels, knots, special structural features and presence of fuse or other initiation device, if any) whenever it is safe and feasible.
5. It guards the device until it is removed from the scene.

The bomb disposal squad after taking over the charge of the explosive/device may:

a. Pick up the device with a remote controlled device, carry it in a live bomb carrier to a safe place, and deactivate it.
b. Freeze the device with liquid nitrogen or carbon dioxide (or other material) and remove it.
c. Disrupt it at the site with shotgun, gas gun or water cannon if it is safe to do so.
d. Jam the device with POP solution, resins or foam.
e. Submerge the device in water if they are sure that water would not explode it.
f. Let it age (only in an open space) when it does not interfere with the public routine. However, it is guarded during the aging period.

The safety of the team takes priority. The safety measures depend on the nature of the device (and explosive), its location, size and the calculated hazard involved. The squad usually has:

1. Protective suit for the operator including protective helmet.
2. Blast container.
3. Bomb suppression blanket(s).
4. Explosive detectors, including sniffer dog.
5. Contactless stethoscope.
6. Metals detectors.
7. Probes for probing hidden bombs.
8. Extension mirrors, to check areas not directly visible.
9. Endoscope.
10. Fibroscope.
11. Thermal cutter.
12. Bomb Disrupters.
13. Door opening kit for rooms, cars, safes, etc.

The cities and places prone to frequent bomb attacks should have a well-equipped/properly trained police bomb disposal squad to reduce the response time and thereby reduce the danger of the device.

9.3 Disposal of Explosives/IEDS

The disposal of live bomb needs all the care, not only from the safety angle but also for the preservation of the incriminating evidence, to pin the guilt to the culprit. The following steps help to preserve the evidence:

1. Allow the device to age at the site, if possible.
2. Photograph the explosive device at site covering labels, knots, special structural features and the presence of fuse cord or other initiation device,

The various ways for the disposal of explosive devices are:

1. Explode the device

Explode the device, after collecting the evidence, at the site where it is discovered, if it is safe to do so and the process does not damage the surroundings. The explosion destroys most of the incriminating evidence about the device. Besides, it is impracticable in most of the cases, as the explosive devices are placed mostly at busy sites (buildings, vehicles,etc.). It is not possible to explode the device at such sites.

2. Quench the explosive device

The device is put in a bucket of water and allowed to soak thoroughly. Water enters into the explosive device and renders it effective. The quenching mode was quite effective in the old times because the usual explosive material used to be black powder, which would become ineffective on drenching. The explosive materials have changed since. Water has no effect on some new explosives.

Light oil has also been recommended as the soaking medium. It has one advantage over water. The device, which may explode on contact with water (for example, by completing an electrical circuit), will be safe in the oil.

The 'quenching' process spoils or destroys the evidence like fingerprints, writings, etc., on the body of the device. Such evidence is photographed whenever possible, before using this technique.

3. Dismantle the explosive device

Dismantling the device preserves the evidence. It can be done only if the opening of the device is safe. Only an explosive expert who is familiar with the device and has the necessary equipment, expertise and experience to do so, decides the mode.

A practical way to handle and dispose of an infernal device involves the following steps:

1. The device is not dragged, tilted, turned or overturned.
2. A remote control robotic device picks up the device from the site.
3. It is placed in a shockproof, specially made carriage. It has a 10 cm thick steel tube. The tube is open both at the top and at the bottom ends. There is a steel wire cage hung inside the tube in the centre. The infernal device is placed inside the cage. The tube is fixed behind the carriage. If the infernal device explodes during transport, the pressure waves will go upwards or downwards. The spaces at the sides remain unaffected. Thus, practically no damage is caused even if the device explodes en route.
4. The device is taken to a safe place away from the inhabited areas.
5. The device is allowed to age for three days.
6. It is turned by a remote controlled device; left for a few hours and then over-turned; then left again for a few hours more.

7. The infernal device is opened from an unexpected place. For example, if the device is tied with a rope or string, it is cut. If there is a soldered joint, it is dissolved in mercury. It is not hammered or sawed.
8. Metal parts are removed by the action of sulphuric acid (10%).

Minimum of force is used in all these operations.

The circumstances of each case – location, size of the device and calculated hazard involved – determine the disposal mode.

All items, explosive charge, initiators, container, wrapper, string, wire, paper, wiring, fibre, cloth, tape, clockwork, switches, caps and adventitious materials such as hair, dust, dirt, paint and tools are evidence. They are collected.

If the explosive device is considered dangerous, it is destroyed at the earliest with the help of a bomb disposal expert.

4. Dispatch

The inspectors of explosives, located at different places, were the authorized persons to handle the evidence until some decades ago. Now the explosive experts of Forensic Science Laboratories carry out the examination of explosives, explosive devices, and their explosion products. The experts normally visit the scene of explosions and assist the investigator to locate, collect and pack the correct clues.

The items sent to the laboratories are primarily the products of explosion from the explosive device and those items, which are not likely to explode in transit.

The expert usually examines the live explosive devices at the scene itself. Only those items, which the expert wants to examine in the laboratory, are collected, packed, sealed and sent. The expert guides the investigator to pack the correct amount correctly to avoid accidental explosion in transit.

If the expert is not available at the scene, only safe devices are collected, packed and dispatched, after consulting the expert on telephone. Other evidence, products of explosions and extraneous objects, marks, etc. are sent as usual.

The following reminders are useful while dispatching explosion related exhibits to the laboratory:

1. A special messenger should take the exhibits to the laboratory, especially when live explosives are also being sent.
2. Only a representative sample (a few grams only) of the explosive is sent.
3. Explosives and initiating device (detonators: one or two only) are packed separately.
4. The Station Master is informed that the special messenger is carrying explosives in the train.
5. Dangerous explosives or explosive devices are not sent to the laboratory without defusing them. The expert usually examines them at the scene.
6. Fulminates, azides, styphnates, and self-igniting incendiary solid or liquid mixtures (chlorates mixtures, phosphorous solution, bombs, etc.) are dangerous explosives.

10. EXPLOSIONS

10.1 Accidental Explosion

Accidental explosions do occur now and then, because explosives are usually unstable compounds. They are highly susceptible to various impulses. An accidental impulse can explode them. This can happen during their manufacture, transport, storage or in handling, even with the best of care and precautions.

On August 16, 2001, a devastating explosion took place in a detonators factory. The explosion started in the crimping unit of the factory.

The explosion razed the building to the ground, killing 25 persons and injuring some others. Hundreds of persons and six fire tenders could bring the fire under control. Huge piles of debris and the fear of more explosions from possible live explosives in the debris hampered their work.

The manufacture of detonators involves highly sensitive explosives like lead styphanate, lead azide and PETN. The former two are highly sensitive and explode even on rubbing or falling. (CH)

Pyrotechnics are involved in many accidental explosions. Hundreds of children are injured while playing with crackers every year in the festival seasons.

Accidental explosions, sometimes serious, occur mainly due to mishandling of the explosives. It may be due to ignorance about the explosive or just negligence. Circumstances under which accidents occur include:

1. Children mishandle crackers while playing with them on festivals like Diwali.
2. Something goes wrong in the manufacture, transport, storage and handling of the crackers, military explosives and explosive devices.
3. Accidental non-explosive explosions, due to leakage of fuel gas (LPG/CNG) cylinders, but sometimes leakage is with criminal intent and causes serious explosions. The correct nature of the explosive is essential to ascertain/establish/disprove/confirm the source of the explosive/explosion.

   In a case of embezzlement of a substantial amount of money in an office, the fraudsters decided to destroy the record, which was likely to incriminate them. They sprinkled about five litres of petrol on the files one evening after the office hours. The files were kept near a window where a small glass windowpane had been removed. They returned to the scene at night after about six hours, lit a matchstick and threw it in through the window. There was a flash and an explosion. It damaged the doors, windows and walls.

   The author visited/examined the explosion site immediately after the incident. The files were still dripping with petrol. They were, however, not burnt, though the edges of the top ones had been somewhat singed.

   The evaporation of petrol had filled the room with its vapours, forming an explosive mixture with air. The matchstick flame exploded the mixture. The explosion consumed most of the room oxygen, extinguished the fire and failed

to burn the incriminating documents, due to insufficient oxygen concentration in the room air!

The explosion had another unexpected consequence. The blast pushed out hot gas through the opening in the window with the missing glass windowpane, singeing the face of the culprit who had applied the flame and was watching the result of his act. The scorched face hot gases provided an undeniable stamp of his presence at the scene. (CH)

4. Stored explosives may undergo auto-oxidation or decomposition. Heat generated in the process explodes the explosives.

Extensive destruction and unpredictability of possible additional explosions make investigation highly dangerous and time consuming.

Accidental explosions occur because explosives are usually unstable compounds. They are highly susceptible to various impulses. An accidental impulse can explode them. This can happen during their manufacture, transport, storage or in handling, even with the best of care and precautions.

On August 16, 2001, a devastating explosion took place in a detonators factory. The explosion started in the crimping unit of the factory.

The explosion razed the building to the ground, killing 25 persons and injuring some others. Hundreds of persons and six fire tenders could bring the fire under control. Huge piles of debris and the fear of more explosions from possible live explosives in the debris hampered their work.

The manufacture of detonators involves highly sensitive explosives like lead styphanate, lead azide and PETN. All are highly sensitive and explode easily. (CH)

11. INVESTIGATIONS

The Supreme Court has provided guidelines for successful investigation and prosecution of any crime. The investigation and prosecution agencies must provide convincing evidence on the following facets of the occurrence:

1. A crime has been committed.
2. The accused had the means, motive and the opportunity to commit the crime.
3. The accused committed the crime.

The scene of an explosion is a venue that provides important evidence on various aspects of explosion. It is a daunting task. Explosion scene covers large areas, create huge amount of debris, extensive destruction, not only of the place but also of the explosive device and near-complete destruction of the explosive used. The examination requires adequate experience, work force, time and patience. Proper examination helps to find out:

1. The nature of the explosive and the explosive device.
2. The quantity of the explosive used.
3. The source of the explosive and the explosive device.
4. The mode of initiation.

5. Evidentiary clues to link the criminal with the crime.
6. The target.
7. The victim.

The main purpose of the examination of an explosion is to find evidence about the explosion: its nature, power and about the perpetrator. The main sources of evidentiary clues in explosions are:

1. The scene of the explosion.
2. The culprit, his wearing apparel, shoes, etc.
3. The culprit's vehicle.
4. The culprit's office (documentary evidence!), residence (residual materials) and workshop where he assembles or makes explosive devices.
5. The culprit's computer, if he has one.
6. The culprits' associates or helpers.

11.1 The Scene of Explosion

The scene of explosion is the most important source of evidence. It has the crater, the shattering wave route and the destruction. They indicate the power and possible nature of the explosive used, and of the explosive device itself. In addition, it has evidentiary clues:

1. Traces of the explosive(s) used, flash impacted on the objects around.
2. The shattered pieces of the container.
3. Missiles of the IED or bomb.
4. Remnants of the initiating device (detonator, etc).
5. Remnants of the timing device.
6. Fragments of electrical and electronic systems used, including circuit board etc.
7. Insulating/adhesive tape fragments.

There may be usual clues like fingerprints, footprints, discarded containers, bags, tools, tool marks, blood due to accidental injury, fibres, hair, cigarette stubs, match stick, and the like, which may have survived the explosion. They may help provide linkage of the explosion with the perpetrator.

The scene of explosion is dangerous. There may be live explosives that may explode any time, there may live electrical wires that may electrocute a person, there may be unsafe building structures that may fall and bury the person working there. Safety of the members of the team has the first priority. The leader of the team must ensure the same. In view of the above, the explosion scene evaluation is properly planned and the plan is carefully executed. The scene as well as the evidence found there is properly recorded.

For proper handling of the scene, the following steps are essential.

1. Save life and reduce trauma

The first police officer at the scene attends to the injured, provides medical help and sends them to hospital at the earliest.

2. Protect the scene

Expels all unauthorized persons from the scene, and prevents entry of the new onlookers, passerby or curiosity hunters, including media people, to the site.

3. Barricade the scene

The scene must be barricaded. Usually the periphery of the apparent scene is increased by about 20% to avoid missing some evidence, which may have flown to a longer distance. Encircling the scene with rope or string is adequate.

The pressure wave of the explosion sometimes travels to long distances and carries shattered pieces of the device along with it. The pressure wave route must also be protected and searched for clues.

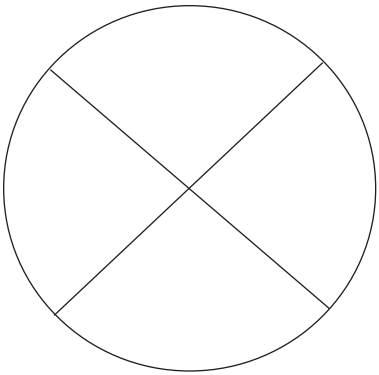


Fig. XXIII-15

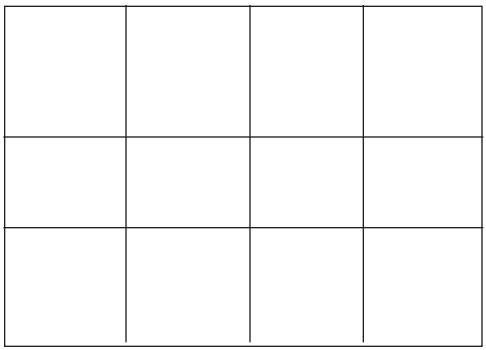


Fig. XXIII-16

Zonal Divisions

4. Divide the Scene in Zones

The scenes of explosions usually cover large areas. It is divided into zones. The examination is taken up zone-wise. Thus, more than one team can search the scene. Even if only one team has to examine the scene, zone formation/ examination ensures a thorough examination.

1. Assess the scene

The scene of an explosion has special needs, as it is usually quite abnormal. The first police official must assess the scene realistically and convey the needs of the investigation to the concerned persons without loss of time. The basic needs are:

2. Special Investigation Team (SIT).

The SIT includes:

(1) A police officer as team leader;
(2) An explosive expert, to diffuse any explosive device which might still be live at the scene and inform about the behavior of the explosive used in the explosion;
(3) A forensic expert to process the evidentiary clues;
(4) A sniffer dog team;
(5) An imaging expert, for photography/videography.

In addition, other experts in the field of electronics, electricity and architecture may be needed at times. The team is formed beforehand. Its members are on call at all hours.

The first police officer may give his idea of the requirements of other specialist(s) whenever needed. He informs the superiors accordingly.

Expert help is indispensable in the examination of the scene of an explosion. The expert should have both practical and scientific knowledge relating to explosives being used or misused in the country.

Different explosives behave in different ways and create different types of explosion waves and patterns, depending upon their nature, quantity, mode of confinement and placement. The expert studies the destruction patterns, which indicate the nature and quantities of the explosives, used. He reconstructs the explosive device and pattern of events. Further, he helps to locate the evidentiary clues that may link the culprit with the crime.

12. EQUIPMENT NEEDED AT THE SCENE

In addition to the usual equipment for documentation, collection of evidentiary clues and handling of the scene, the first police officer also assesses special equipment needed at the explosion site. Usually the following pieces of items are needed:

a. Large amounts of debris at the site may need an earthmover, truck carriers, even cranes.
b. A live explosive device may need a bomb carrier.
c. Expansive scenes may need a helicopter for complete coverage of the scene photographically.
d. Usual gadgets like rakes, shovels, spade etc. to move/remove/sift the debris.
e. Illumination equipment to explore places in dark. This is in addition to powerful hand-torches.
f. Skilled/or non-skilled labour.

The first police officer at the scene of explosion waits until the SIT arrives at the scene. He informs the team head what he has seen and what he has observed. The SIT then takes over the handling of the scene. The team members work according to a plan after carrying out a preliminary examination of the scene.

Once the scene is safe, the investigating officer locates and collects evidence from the scene:

1. Evidence on the device:
    a. Any labels or identifying marks.
    b. Fingerprints, writings, stains, etc.
    c. Extraneous matter such as hair, fibres, dust, paint and tool marks.
    d. Any spilt-over explosive or related material.

2. Footprints, footwear marks and tyre marks, if any, at or near the scene.

Fig. XXIII-17

The scene of a scooter bomb explosion

A huge blast occurred on June 30, 1999 in the busy market of a city. Different agencies and many forensic teams reached the site. The work of collection and evaluation of the clue materials was assigned to the local CFSL. Total blast materials fragments of vehicles, sample of soil from the crater, shock wave study, damage to the surrounding buildings, photographs of the blast pattern including location of clue materials could be gathered. Detailed examination revealed:

1. Cut pieces of hedge wire, used as missile, could be found in the soil of the crater and in the objects at the site.
2. GC-MS of the traces from remnants of the explosive in the soil of the crater and fragments of the container confirmed use of RDX in the IED.
3. Parts of the fragments bearing blast effect, identified the IED carrier, a shattered scooter.
4. Engine number was resuscitation from a metal fragment of the engine.
5. Registration number, could be restored.

The forensic data generated led the investigators to the bomber. (CH)

13. THE EXAMINATION

The examination of the explosions scene involves the following determinations:

1. **The seat of the explosion(s)**

   It is indicated by the pit(s) or crater(s) formed at the site. The crater is photographed along with a scale. It is also sketched and video-filmed. Its dimensions including depth and direction are properly measured and recorded.

2. Traces of the explosives in crater

The traces get flash deposited on/around the crater and on nearby objects. They are located, photographed (whenever possible), collected, packed and sealed. They are useful to build up the IED and connect the criminal with the crime.

3. The shattered pieces of the device

The shattered pieces of the device are found around the crater. They should be located, their identity and location fixed (photography, sketch) and ultimately collected, packed and sealed. There may be scores of pieces of the debris at the site. They may be carrying traces of the explosive used. The pieces should be checked with trace detection devices and sent to the laboratory to identify the explosive. Quantities of explosives on the debris are often small – in pictograms, but with the new crop of instruments, the small quantity of the explosive is no hindrance.

The shattered pieces of the infernal device(s), including those of container, initiators, clockwork (in time bombs) and missiles scatter far and wide They are also found embedded in the nearby objects: in the body of the victims, in the debris or along the wave path.

If the infernal device has been used as an antipersonnel device, the pieces will be found on or in the victims also.

The pieces should be carefully located, collected, documented, packed and sealed. The pieces so collected may give a jigsaw fit to indicate the nature of the original object or device from which they have come. It is seldom that all the pieces are available, but often the pieces available can give a good idea about the nature of the original device.

4. The explosive wave pattern

The wave patterns are characteristic of the explosion, as mentioned previously. The pattern depends upon the nature and the amount of the explosive used and the construction of the explosive device. The examination helps to identify the explosive and the device used. The main characteristics of the wave are:

a. The wave is directional.
b. It takes the path of least resistance.
c. It moves, pushes, shatters and bends the objects in its path depending upon its strength and the resistance of the obstructing object.
d. It may scorch and melt materials nearby, which come in come in contact with the flame or hot gases.
e. The plotting of the positions of the pieces of the device on a graph paper and extending the lines towards the centre can indicate the seat of the explosion correctly.

In a case of murder, dynamite sticks and a blasting cap were used to kill the victim. The explosive was placed underneath the mattress on the floor of a makeshift shed at a quarrying site. The blasting cap was placed in the sticks

and the lead wires connected to a battery. The switch was turned on at night when the victim was asleep. There was an explosion. The body was shattered to small unrecognizable pieces except for the limbs and head. The explosive wave had travelled straight upward and created a hole in the roof of the shed.

The surprising part of the murder was that the head and neck of the victim were in one piece and they carried no other injury. Likewise, another person sleeping about one metre away on the same floor did not suffer any injury. (CH)

5. The shattering wave pattern is recorded

It is distinct. Its intensity and direction provides a lot of information. The evidentiary clues, which may be parts of the infernal device or of the targeted object (victim) fly along the pressure wave, and are found scattered on the path followed by the pressure wave.

Sometimes negative pressure wave is created, it may mislead. Negative wave is caused by the sudden creation of vacuum by the original pressure wave. The negative pressure wave (not very common) may throw or tilt the object in the direction *opposite* to that taken by the actual pressure wave. It often needs care and time to establish the path of the wave. The starting point of the pressure wave(s) indicates the seat of the explosion.

An aerosol explosion in a hotel was caused by gas leaked from an LPG cylinder. The kitchen staff had left the site at about 11 PM. They had partially closed the coal oven but the cinders continued to glow. The leaking LPG and air formed an explosive mixture concentration in about 3 hours. The staff had left the place by that time. As soon as the gas concentration reached the explosive limit, it exploded. The red-hot coal in the oven provided the need heat to ignite the gas mixture, which exploded.

The kitchen was on the third floor, but the gases, being heavier, travelled down to the ground, first and second floors as well. The explosion blew out the doors and windows on all these floors and the shutters on the ground floor bulged out. The maximum damage was on the third floor.

There was little fire. Only a chair and some clothes in the kitchen were singed. (CH)

14. EVIDENTIARY CLUES

Extensive destruction, fragmentation, contamination and the vast area where the clues are scattered at the scene of an explosion, make the search for evidentiary clues an arduous and time-consuming task. Many an investigator loses track of the evidentiary clues because he loses patience in the ordeal.

The following points are kept in view:

1. The area for search at the scene of the explosion is fixed before starting the search. A larger area (~20 % more) than the apparent crime scene area is marked out as the area for search. It should exclude the possibility of missing any clue at the scene.
2. If the crime scene is large, it is divided into zones and the search is carried out zone-wise.

3. Usually the search starts from the focal point – the crater in most of the cases. The spiral search method is used if the scene is not too large.
4. If the centre of explosion (crater) is not clear, the search starts from the outer extreme periphery, and closes at the centre; again if the scene is not too expansive.
5. In the case of a strong directional pressure wave, the path of the wave is followed to locate the evidence in addition to the main scene. The wave path is followed from the initiating point of the wave to the end of the wave path.
6. The crater is examined with particular attention. Its surface and surroundings are likely to retain fragments of the infernal device: initiators, detonators, explosives, containers, missiles, etc. as already mentioned.
7. The size, shape, depth, etc. of the crater are important. The devastation caused and the patterns of damage are important clues to indicate the power and nature of the infernal device.
8. The pressure wave (its size, extent and damage it causes) indicates the nature and the amount of the explosive used.
9. The traditional clues like tool marks, fingerprints, abandoned objects, foot or footwear marks, tyre marks are also often available. They should be searched and collected.
10. Abandoned objects are often important clues. They should be searched for and collected.

Theoretically, there should be a wealth of clue materials at the explosions site - there often is. However, the destruction is extensive and debris is in large quantities, whereas the residual evidence is in minute quantities. It is intermixed and hidden in or covered by heaps of debris. The search and location of evidence, therefore, needs patience, experience and time as well as manual and instrumental help.

14.1 Collection of Clues

Collection of clues from the exploded materials follows the usual pattern[1]. Some of the main principles may be repeated with advantage:

1. The IO gets the scene videographed before collection of the clues.
2. The IO documents the location of the clues through photography, sketches and written textual record.
3. The IO records the condition of the clues before packing.
4. The IO marks the clue for identification before packing.
5. The IO clues collects clues in clean containers and seals them at scene.
6. The IO packs the items collected from different sites separately.
7. The IO signs the recovery memo and puts his initials on the clues wherever possible.

1. *Supra* chapter 9.

8. The IO gets the signatures of the recovery witnesses on the recovery memo in accordance with law.
9. The IO maintains the identity/authenticity/integrity/chain of possession of the clues.

14.2 Dispatch of Clues

The IO dispatches the exhibits methodically:

1. He sends the clues through a special messenger whenever possible in sealed packed.
2. He maintains a log of the movements of the evidentiary clues to ensure unbroken chain of custody.
3. He logs all the clues collected properly in the case diary.
4. He sends the exhibits to the expert along with a letter mentioning the details of the exhibits and the nature of examination required.

14.3 Evidentiary Clues on the Culprit

The culprit may have evidence on his person, on his clothes or at places where he lives or works. The evidence may be:

1. **Explosives Particles** are present on the person of the culprit if he has manufactured/assembled/used the IED himself. In fact, micro traces of the explosives persist on the hands, fingernails and clothes of the culprit for a long time. This is especially true of RDX and other military explosives. The particles are in the worn apparel, hands (swabbing!) and fingernail dirt. It is collected.
2. **Explosives stains** are found on the person or clothes of the culprit.
3. **Explosive vapours/particles** are present in debris from the scene of explosion in the hair, on the clothes or in the welt of the shoes of the persons present at the explosion scene.
4. **Injuries on culprit,** from the exploded material form useful evidence.

   In a case, a person working in an office poured petrol on some 'offensive' files at the time of closing the office. The culprit returned some hours later at night and threw a burning matchstick on to the documents through a broken windowpane. The petrol vapours and air had formed an explosive aerosol in the meanwhile. There was an explosion. Hot gases coming out of the broken window singed his face of the culprit, imprinting identifying mark of his involvement in the deed. (CH)
5. **Fragments of the explosive/device,** embedded on the culprit or on his clothes.

14.4 Evidence in the Vehicle

Culprits often use vehicles to reach the scene and to carry the infernal device. They later abandon the vehicle. The vehicles carry evidence, including the following**:**

1. Dust, dirt and debris from the scene.
2. Standard tyre marks for comparison of the tyre marks found at the scene.
3. The traces of explosive from the infernal device may still be in the vehicle. If the explosive is kept in the vehicle for appreciable time, vapours of the explosives diffuse in the car air.
4. Particles/stains/odours of the explosives kept in the vehicle.
5. Bio evidence like bloodstain/hair/fibres, if the culprit has been injured or the injured victim or accomplice was carried in the vehicle.
6. Fingerprints of the culprit for comparison with those found at the scene.

14.5 Evidence at Residence/Work Site

The premises used for assembling or preparing infernal devices are a rich source of evidence:

1. The residual material, chemicals and other materials used for the making the device.
2. The tools used for the assembly.
3. The additional devices, if the culprit is a professional saboteur.
4. Unused containers/initiators/explosive materials/missiles. The linkage of the items with the corresponding materials used in the IED identified the culprit.
5. Evidence relating to storage, manufacture or assembling activities.
6. Additional IEDs at the premises.
7. Notebooks or diaries and the like containing information relating to the explosives materials/associates/suppliers/clients (terrorist group) involved in the explosives/explosion.

If the culprit is living with a family, he may carry out these activities without making them aware of his activities. In such cases, he uses a place that is not visited frequently by the other members. Abandoned sheds or garages are the usual sites.

The site of the manufacture of IEDs is often dangerous. It may have dangerous chemicals, incomplete (or complete) IEDs, which may go off. There may be a booby trap even; set up to destroy the premises in case they are discovered. The IO/SIT examines the site, with an eye on the danger.

15. DISPOSAL OF IEDS

Fig. XXIII-18

An IED destroyed by exploding it in a secluded place

The disposal of live bomb needs all the care, not only from the safety but also for the preservation of the incriminating evidence, to pin the guilt to the culprit. The following steps help to preserve the evidence:

(1) Allow the device to age at the site, if possible.

(2) Photograph the explosive device at site covering labels, knots, special structural features and the presence of fuse cord or other initiation device.

There are many ways for the disposal of explosive devices. The bomb disposal squad decides the mode, to minimise the risk/damage. The usual methods are:

15.1 Explode the Device

If it is safe to explode the device at the site where it is discovered, it is the first choice. However, the option is rarely available as the devices are usually found in buildings, vehicles or other areas frequented by the public. The process would damage the surroundings. Besides, the explosion will destroy most of the incriminating evidence relating to the structure and components of the device.

15.2 Quench the Explosive Device

The device is soaked thoroughly in a bucket of water. Water enters into the explosive device and renders it ineffective. The quenching mode was quite effective in the old times because the usual explosive material used to be black powder, which would become ineffective on drenching. The explosive materials have changed since. Water has no effect on some new explosives.

Light mineral oil is also used as the soaking medium. It has one advantage over water. The device, which may explode on contact with water (for example, by completing an electrical circuit), will not blow off in oil.

The 'quenching' process spoils or destroys the evidence like fingerprints, writings, etc., on the body of the device. Such evidence is photographed whenever possible, before using this technique.

15.3 Dismantle the Explosive Device

If the device is dismantled, the evidence on the device is preserved. It is possible if the construction features of the device are understood/known and the opening of the device is safe. Only a bomb disposal squad should do it. The squad has the necessary equipment, expertise and experience to do so.

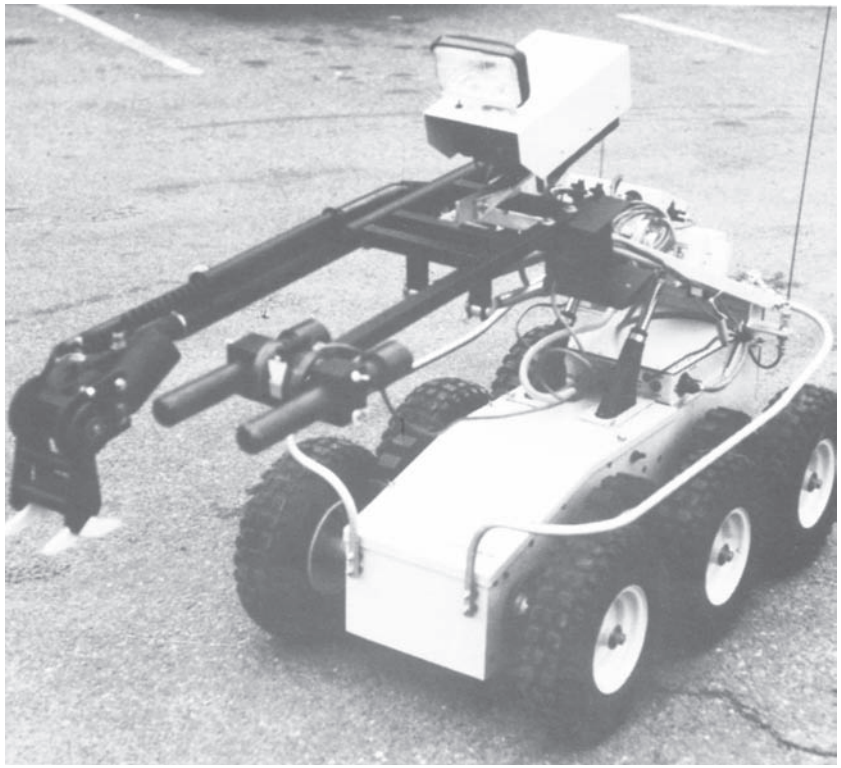


Fig. XXIII-19

Remote control explosive handling device.

A practical way to handle and dispose of an infernal device involves the following steps:

1. The device is neither dragged, nor tilted, turned or overturned.
2. A remote control robotic device picks up the device from the site.

   It is placed in a shockproof, specially made carriage. It has a 10 cm thick steel tube, with both at the top and at the bottom ends open. There is a steel wire cage hung inside the tube in the centre. A robot

picks up the device from the site and places it in the cage. The tube is fixed behind the carriage. If the infernal device explodes during transport, the pressure waves will go upwards or downwards. The side surroundings remain unaffected. Thus, practically no damage is caused even if the device explodes en route.

3. The device is taken to a safe place away from the inhabited areas.
4. The device is allowed to age for three days.
5. It is turned by a remote controlled device; left for a few hours and then over-turned; then left again for a few hours more.
6. The infernal device is opened from an unexpected place. For example, if the device is tied with a rope or string, it is cut. If there is a soldered joint, it is dissolved in mercury. It is not hammered or sawed.
7. Metal parts are removed by the action of sulphuric acid (10%).

Minimum force is used in all these operations.

The circumstances of each case – location, size of the device and calculated hazard involved – determine the disposal mode.

All items, explosive charge, initiators, container, wrapper, string, wire, paper, wiring, fibre, cloth, tape, clockwork, switches, caps and adventitious materials such as hair, dust, dirt, paint and tools are evidence. They are collected whenever it is safe to do so.

A dangerous explosive device is destroyed at the earliest with the help of a bomb disposal squad.

15.4 Dispatch

The inspectors of explosives, located at different places, handle the explosives/devices and the evidence, previously. Now the handling/examination is done by:

1. Explosive experts of Forensic Science Laboratories.
2. National Security Guard (NSG)/National Investigating Agency (NIA).
3. Military bomb disposal team examines the explosives, explosive devices, and their explosion products. The experts normally visit the scene of explosions and assist the investigator to locate, collect and pack the correct clues.

The items sent to the laboratories are primarily the products of explosion from the explosive device and those items that are not likely to explode in transit.

The expert usually examines the live explosive devices at the scene itself. Only those items, which the expert wants to examine in the laboratory, are collected/packed/sealed and sent to the laboratory. The expert guides the investigator to pack the correct amount correctly to avoid accidental explosion in transit.

If the expert is not available at the scene, only safe devices are collected/packed/dispatched, after consulting the expert on telephone. Other evidence, products of explosions and extraneous objects, marks, etc. are sent as usual.

The following reminders are useful while dispatching explosion related exhibits to the laboratory:

1. The exhibits are sent to the laboratory through a special messenger, especially when live explosives are being sent.
2. Only a representative sample (a few grams only) of the explosive is sent.
3. Explosives and initiating device (detonators: one or two only) are packed separately.
4. The stationmaster is informed that special messenger is carrying explosives.
5. Dangerous explosives or explosive devices are sent after defusing them.
6. Fulminates, azides, styphnates, and self-igniting incendiary solid/liquid mixtures (chlorates mixtures, phosphorous solution, bombs, etc.) are dangerous explosives. They are transported with extra care.

16. PROBLEMS

An explosive expert can provide answers to the following questions:

1. **Is the given material an explosive?**

   The expert determines the nature of the explosive and may link the case with similar other cases who have used similar explosive.

2. **Is the given contrivance an explosive device?**

   The expert can identify the device as an IED. In addition, he can link the device to other IEDs used in other cases or recovered from the suspects. Thus, he inter-links the serial blasts and indicates the possibility of a common perpetrator (s).

3. **What was the *modus operandi*?**

   The expert can indicate the *modus operandi* of the culprit. The information helps the law keepers to prevent future explosions.

   Similar *modus operandi* in various blasts, inter-links the blast at different places.

4. **Is the explosive device involved in the case an IED or a military bomb?**

   This is comparatively easy to answer. The standard military bombs carry information written on them and they have proper finish. The IEDs carry no legends and do not have proper finish.

5. **How was the infernal device initiated?**

   An expert identifies the initiating devices in the exploded IEDs from the fragments of the initiators, most of the time. Fragments of batteries, clock-work, detonator, etc. provide the evidence.

6. **Was a similar explosive/explosive device used in any other cases(s)?**

   The expert as already seen, can link/de-link explosive/explosive devices used in different cases by comparing the data/evidence available from the cases under review.

7. **Can the culprit/manufacturer be linked to the IED/explosive/explosion?**

   The expert can link the person who has handled the explosive/IED/explosion through comparison of traces of explosive, which are transferred to the culprit. There is no practical lower limit for analysis of traces. Analytical techniques have crossed all physical barriers.

8. **Can non-explosive explosion be identified/distinguished?**

   Yes. Fuel gases, volatile organic liquids and finely dispersed organic powders form aerosols. The ingredients can be identified. The initiation is different. In addition, the aerosols have characteristic destruction patterns. They discriminate the explosions from explosive/non-explosive explosions.

9. **Is the explosion accidental or intentional?**

   It is not always possible to discriminate between the accidental and intentional explosions. In some cases, there may be evidence available to determine the same; in others, the evidence may not be there.

10. **What was the level of expertise used in the manufacture of the IED?**

    This question can be answered in most of the cases form the quality of the product and the ingredients used.

11. **Can an IED be linked with the site where it was assembled/made?**

    Ordinarily, the site has plenty of evidence to link the IED with the premises where it was assembled/made. It is in the form of residual materials used in the manufacture of the device.

In a mid-night blast, a double storey building of a local police station was raised to the ground. Huge amount of debris was searched and primary fragments formed due to the blast shown in the photograph could be located. Typical fragments indicted conclusively to form Steel Tiffin box, which helped the police to nab the culprits responsible for the blast.

Explosive substance RDX causing the blast could also be detected/identified. (CH)

Fig. XXIII-20

Fragments of Tiffin bomb (RDX)

12. **Was the given vehicle used to carry the IEDs?**

    If the vehicle is examined soon after its use to carry the explosive device, it is possible to identify it as the carrier of the infernal device. There are traces of the explosive/its disintegrated products in the vehicle. Delay may finish the traces. Besides, the construction of the device also affects the amount and nature of evidentiary clues available.

13. **Was the explosion accidental, due to negligence? Alternatively, was it due to defective manufacture of the cracker?**

    It is difficult to answer this question with certainty in most of the cases.

14. **Can the evidence connect the culprit with the explosive/device/ explosion?**

    It is possible in most of the cases.

17. EVALUATION

The evaluation of the evidence found at the scene of explosion, with the culprit, at his residence/office/work site, on his vehicle or en route help to ascertain the following:

1. The nature of the incidence,
2. The type of the explosive or explosive device used, and
3. The linkage/de-linkage of the evidentiary clues with the perpetrator/ explosion site/assembly site/manufacturing site/other explosions.

The investigator has, therefore, to ensure to locate, collect, pack, seal and dispatch the evidentiary clues with all the formalities to maintain their relevancy, integrity, authenticity and continuity. He should get the exhibits analysed at the earliest so that the expert can provides him leads for a correct and early solution of the case.

The main evidentiary clues at the explosion site are:

1. **Vapours of explosives**

   Explosives/their disintegrated products give out vapours continuously. They are available at sites of blasts, in the crater of the blast, and adsorbed on the absorbent surfaces surrounding the blast sites and in the debris. They are also found in the clothes of the handlers of the explosives.

   The vapours from the air are collected by passing the air from the suspected entity to some adsorbent (charcoal or some synthetic substitute). Later, for identification, the vapours are desorbed on heating; or, extracted through solvents.

   Electronic gadgets detect/identify the de- adsorbed vapours.

2. **Unexploded explosive**

   Unexploded explosive are often available at the site. They are flash impacted on the surfaces and objects close to the explosion site. However, they are only in traces in most of the cases. They persist for a long time if not washed away by wind or rain. Adsorption on the surfaces retains

them for a long time. The explosive traces in the form of clusters of micro crystals and decomposition products may also be found in the air of the enclosed areas like a room or vehicle.

3. **Explosive residues**

   Some quantity of the explosive, if exploded in a non-confined space, may escape explosion. The leftover explosive provides easy identification. Besides, decomposed explosive leave fragments of the explosive. The identification of the fragments leads to the identity of the explosive used.

4. **Fragments of the parts of the device**

   The structural materials of the device shatter on explosion. They are container, timing device, initiators, detonators, batteries, clocks, and electronic devices used for initiation through remote control. They are often shattered, but at times, they can be fitted into a jigsaw to permit their identity.

5. **Burn marks**

   Detonating cord left leave burn marks on the surface where it was placed.

   The mark indicates that detonation cord was used to initiate the explosion. It also indicates the position of the explosive device *vis-à-vis* the position of the perpetrator.

6. **Electric blasting cap**

7. If an electric blasting cap is used to initiate the explosion, the insulating material of the wire and fragments of the cap often form useful clues.

8. **Missiles**

   Makeshift missiles like nails, ball bearings, nuts, bolts etc. are frequently used in IEDs. They may be found at the scene or in the body of the victim(s). They prove useful to link the assembler of the device if similar materials are recovered from the suspect.

9. **Electrical insulating tape and hook up wires**

   Electrical insulating tape and hook up wires are used sometimes in time delay IEDs. They survive the explosion in some cases. They may help to link the criminal with the crime.

The expert in the laboratory can piece together the materials recovered and come up with a reconstructed entity, which often permits identification of the original IED.

17.1 Evidence in Debris

Explosions create heaps of debris and leave traces of the explosives and the other materials used in the IED in a fine state. The residues are intermingled with heaps of dirt, dust and rubble.

It was a daunting task to locate/identify the traces of the explosives/explosive devices because of the quantities and contaminations involved, previously. Not

so now. Enlarged investigative teams and equipment have made the task easier. Often electronic detectors are used to detect residual explosives impacted on the debris. Mechanical devices are used to sift the debris.

The sifted material is examined thoroughly, visually and microscopically. A stereomicroscope with extended arm is useful.

1. Separation or Extraction

The following sources are comparatively richer in explosive residues. They are used to separate/extract the explosive residues/shattered pieces of the IED.

(1) The **surface of the crater** (and the soil to some depth) is the most important site to recover traces of the explosives and the explosive devices. Sometimes even the fragments of the devices are driven into the soil, including those of the initiators, detonators, boosters, containers, missiles, etc. They are found embedded in the crater surface.

(2) The **surface and objects surrounding the seat.**

The surface and objects surrounding the seat carry adsorbed traces of explosives or impacted fragments of the device.

(3) The **pressure wave** route.

High explosives, on explosion, start a pressure wave, which is often unidirectional. Articles displaced or disturbed in the path are likely to carry traces of the explosive residue and fragments of the device, etc. They provide useful evidence in the reconstruction of various aspects of the explosion.

(4) The **blasted items (animate or inanimate).**

They are other important sources of evidentiary clues. They are similar to those items found in the crater debris.

In a railway compartment, dynamite sticks were used as an IED placed on luggage shelf, which was made of plank-like metallic flats with empty spaces in between. When the site was examined after the explosion, a part of the dynamite was found still sticking to the metallic plank. Perhaps the metallic plank prevented the transmission of the shock wave to the unexploded dynamite. (CH)

2. Identification of the Explosive

The debris from the explosion scene is examined in the laboratory to find out:

(1) The presence and nature of the explosive

Gas chromatography is the technique of choice. The vapours of the explosive are collected, concentrated, and then analysed to ascertain the presence and identify the explosive.

(2) The debris likely to carry explosion residues is examined under a stereomicroscope and suspected explosion materials, especially the fragmented pieces of the non-explosive components of the device, are picked out manually for a detailed examination.

(3) After the stereo-microscopic sorting, the debris undergoes extraction with solvents (acetone, chloroform). Organic constituents of the explosion residues are extracted with the organic solvents. Inorganic constituents are extracted with hot water. The extracts are concentrated and tested for the constituents.

The identification procedures are similar to most of the explosive. TLC, IP, IR, XRD, GC-MS, HPLC and HPLC-MS instruments and techniques are useful for organic constituents[1]. IP, IR, XRD and SEM-EDX are useful instrument to identify inorganic constituents.

17.2 Preliminary Tests

An explosive is identified by the following preliminary tests. In all tests, only a small amount of the material is taken. The small quantities eliminate the danger of accident.

1. Friction Test

Some explosives are sensitive to friction. They explode when rubbed against rough surfaces. A trace of the suspected material is placed on a stone slab. The material is scratched with a metre-long bamboo stick. The experiment is repeated with increasing amounts of the material. If the material catches fire, it is an explosive.

2. Impact Test

Some explosives are impact sensitive. They are tested with a hammer blow. A small quantity (starting from a trace and increasing the amount gradually to a pinch) is taken on a piece of paper, kept on a standard anvil and struck with the hammer. An explosion indicates that the material is an explosive. The experiment is repeated about half a dozen times in case it does not explode, to make sure of the fact.

3. Flame Test

A small amount of the material under test is taken on the tip of a strip of paper. If he material is liquid, the paper is dipped in the liquid to absorb a fraction of a drop of the liquid and dried. The paper tip is then exposed to a candle flame. If the burning takes place violently, it is possibly an explosive. The colour of the flame may indicate the nature of explosive.

1. Supra page 19-20 of this chapter.

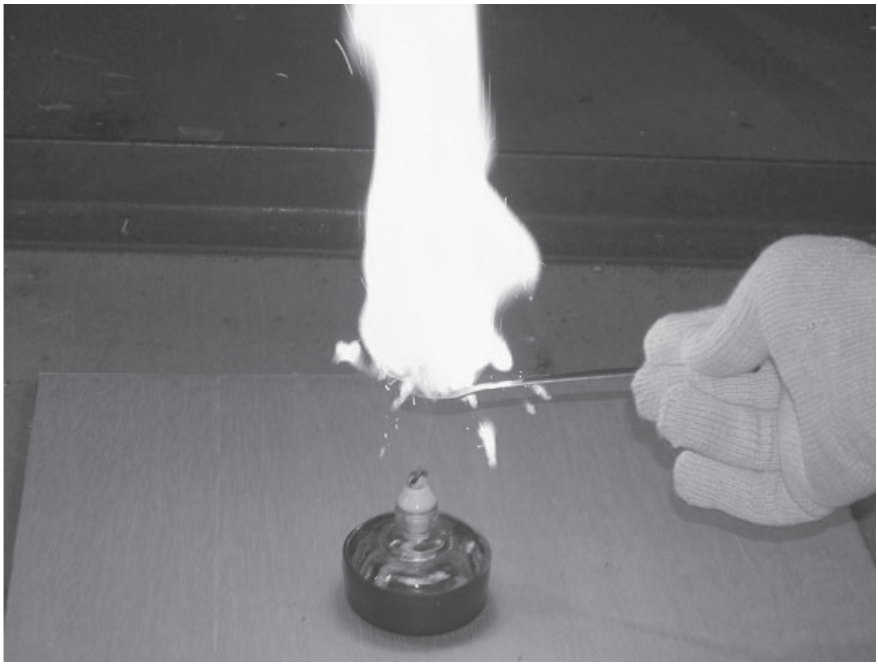


Fig. XXIII-21

Flame test indicate explosive

18. NEW FACILITIES

Explosives, explosive devices and explosions were rare phenomenon in India, about three decades ago. Neither the public nor the law keepers had to bother much. Terrorism has changed the scenario over the years. Explosions continuing from the eighties have changed the whole context. There have been so many explosions in these 3-4 decades that nobody feels safe.

The terrorists have adopted new sophistications. They are using powerful explosion. They choose their own targets/timing. They employ fanatics (*Fidayeens*) who sacrifice their lives on the drop of a pin. They observe no law or moral code. Thus, they have created a dangerously challenging position to the law keepers, who have to act within law/moral code and who have no hypnotized force to act. Yet they have to meet the menace. The police have join hands with the intelligence agencies on the one hand and the explosives and forensic experts on the other hand. In addition, they are adopting modern technology. The combined efforts, it is hoped, will provide the necessary synergy to meet the menace effectively.

The government is taking the following steps to meet the challenges of the terrorist squarely:

18.1 Creation of Explosive Division in FSLs

The investigation of explosion is cost/time/expertise intensive. The presence of expert at the explosion scene is indispensable. He needs long hours in the

laboratories and the courts need him at the trials where often to spend days to answer the crafty cross-examination. The volume of work, the needed high expertise and proof beyond reasonable doubt for the court have created the need for the creation of full-fledged Explosive Divisions. Their work is already well-defined:

1. Analysis of pyrotechnic mixtures, low and high explosive substances and their preparations/formulations.
2. Analysis of improvised explosive mixtures.
3. Identification of plain/electric detonators and their fragments.
4. Ascertain electric and non electric initiation (triggering) mechanisms.
5. Identification of IEDs, their components in the exploded/unexploded explosives.
6. Identification and evaluation of LPG explosions.
7. Characterization of live/exploded/diffused hand grenades.
8. Identification of various types of delay mechanism from the original or from their fragments.
9. Reconstruction of sequence of occurrence of the blasts from the available information.
10. Plan and adopt preventive methodology.
11. Identification of explosive substance or ascertaining original formulations used in improvised explosive devices from the samples collected from the blast sites.
12. Inter-link various explosion.
13. Creation of a data bank of IEDs/their components.
14. Profiling the perpetrators/modus operandi/target sites.
15. To conduct research to develop methods to tackle various facets of bombing crimes.
16. Validation of test methods (SOPs).
17. Calibration of the instruments.
18. Maintaining the integrity of reference standards.
19. Interconnect different bomb blasts, build their profiles.
20. Revisit old blast sites to collect more clues appropriate to the investigation.
21. Liaison with other FSLs to share modes/methods of bombings/explosion.
22. Study and evaluation of different blasts (old/new) to connect the perpetrators of different bombings from the clue materials such as initiation mechanism, explosive formulations, the containers housing the device and other mechanisms controlling the device for its blast to occur in an intended way.
23. Creation of a museum of the explosives/IEDs and their components.

18.2 Induction of modern equipment

New equipment like SEM, Ion exchange chromatography, GC-MS, LC-MS, IR Spectrophotometery and mass spectrometry need induction in Explosive Division of forensic science laboratories to study, estimation and analyse:

1. The fragments and crystal structure changes to identify primary and secondary fragments.
2. The particles recovered from the craters or blast points to identify detonators or initiation devices.
3. The residues from the blast sites for detection and estimation of cations and anions for identification of inorganic substances.
4. The unexploded explosive substances for their identification.

18.3 Creation of Low Temperature Storage Facility

Many explosive substances like TATP, Nitroglycerine and explosion products are volatile in nature. Samples collected from the explosion/blast sites need be stored at low temperature to avoid loss of volatile substances.

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CASE LAWS

1. ON EVIDENTIARY CLUES

1.1 No gun work!: Differentiation of marks on 2 CCs[1]

These statutory appeals are filed under section 2(a) of the Supreme Court (Enlargement of Criminal Appellate Jurisdiction) Act, 1970 and under section 379 of the Criminal Procedure Code against the final judgment and order dated 18/20.12.2006 passed by the High Court of Delhi in Criminal Appeal No. 193 of 2006 whereby the High Court reversed the order of acquittal dated 21.02.2006 passed by the Additional Sessions Judge, Delhi, in Sessions Case No. 105 of 2001, and convicted Sidhartha Vashisht @ Manu Sharma (appellant in Crl. A. No. 179 of 2007) under section 302, 201/120B, IPC and section 27 of the Arms Act and sentenced him to undergo imprisonment for life for the offence under section 302, IPC together with a fine of Rs. 50,000 to be paid to the family of the victim and in default of payment of fine, to undergo further imprisonment for three years and also sentenced him to undergo imprisonment for four years for the offence under section 27 of the Arms Act with a fine of Rs. 2000 and in default to further undergo imprisonment for three months. He was further sentenced to undergo imprisonment for four years for the offence under section 201/120B, IPC together with a fine of Rs. 2,000 and, in default, to further undergo imprisonment for three months. The High Court also sentenced Amardeep Singh Gill @ Tony Gill (appellant in Crl. A. No. 157/2007) and Vikas Yadav (appellant in Crl. A. No. 224/2007) to undergo rigorous imprisonment for four years and a fine of Rs. 2000 each and, in default of payment of fine, to further undergo imprisonment for three months under section 201/120B, IPC.

(2) The case of the prosecution:

(a) On night intervening 29-30.04.1999, a 'Thursday Party' was going on at Qutub Colonnade at "Once upon a time" restaurant also called "Tamarind Cafi". The liquor was being served by the bartenders, namely, Jessica Lal (since deceased) and one Shyan Munshi (PW-2). At about 2.00 a.m., Sidhartha Vashisht @ Manu Sharma (appellant in Crl. A. No. 179 of 2007) along with his friends came there and asked for two drinks. The waiter did not serve him liquor as the party was over. Jessica Lal and Malini Ramani (PW-6), who were also present there, tried to make him understand that the party was over and there was no liquor available with them. On refusal to serve liquor, the appellant took out a pistol and fired one shot at the roof and another at Jessica

1. *Sidarth Vashisht @ Manu Sharma* v. *State of Delhi NCT*, (2010) 6 SCC 1.

Lal which hit near her left eye as a result of which she fell down. Beena Ramani (PW-20), who was present there, stopped the appellant and questioned him as to why he had shot Jessica Lal and demanded the weapon from him but he did not hand over the pistol and fled away. Jessica Lal was rushed to Ashlok Hospital from where she was shifted to Apollo Hospital. On 30.04.1999, in the early morning hours, Jessica Lal was declared brought dead at Apollo Hospital.

(b) On the night intervening 29/30.04.1999 at 2.20 a.m., DD Entry No. 41A (Ex. PW-13/A) was recorded at Police Station Mehrauli which disclosed a shooting incident at H-5/6 Qutub Colonnade. A copy of the said DD entry was handed over to SI Sharad Kumar (PW-78) who along with Ct. Meenu Mathew left for the spot. Near about the same time, copy of the said DD entry was also given to SI Sunil Kumar (PW-100) who along with Ct. Subhash also left for the spot. On reaching the spot, PW-78 found that the injured had been removed to Ashlok Hospital and the floor of the Restaurant was found to be wet. SI Sunil Kumar (PW-100) then left SI Sharad Kumar (PW-78) at the spot to guard the same and proceeded to Ashlok Hospital along with Ct. Subhash. The SHO Police Station Mehrauli, Inspector S.K. Sharma (PW-101) along with his team also left the Police Station *vide* DD Entry No. 43A and reached the spot and deputed one Home Guard Shravan Kumar (PW 30) at the entrance of 'Qutub Colonnade' to guard the vehicles. On reaching Ashlok Hospital, PW-100 met Beena Ramani (PW-20), who is the owner of the Restaurant, and enquired about the incident but she asked him to talk to Shyan Munshi (PW-2) saying that he was inside and he knew everything. PW-100 then recorded the statement of PW-2 and made an endorsement on the same for the registration of the case under section 307, IPC and handed over it to Ct. Subhash to be carried to the police station, Mehrauli. At about 4.00 a.m., FIR No. 287/99 was registered at the police station, Mehrauli. In the meantime, Jessica Lal had been shifted to Apollo Hospital. When SI Sunil Kumar came back to the spot along with PW-2, PW 30 informed them about the lifting of one black Tata Safari from the spot. On inspection of the site, two empty cartridges were seized and, in the meantime, a supplementary statement of PW-2 was also recorded by PW-100. At about 5.45 a.m., PW-100 received an information by Ct. Satyavan intimating him about the death of Jessica Lal at Apollo Hospital. Charge under section 302 IPC/201/120 B IPC and under section 27 of the Arms Act has been framed against the accused Sidhartha Vashisht @ Manu Sharma, charge under section 201/120B, IPC has been framed against accused Vikas Yadav, Amardeep Singh Gill @ Tony Gill and Alok Khanna, charge under section 212, IPC has been framed against Harvinder Chopra, Raja Chopra, Vikas Gill @ Ruby Gill and Yograj Singh and charge under section 201/212, IPC against Shyam Sunder Sharma. At about 7.00 a.m. PW 100 recorded the statement of the Manager (PW-47), Waiter (PW-46) and Beena Ramani (PW-20) the owner of the Restaurant.

(c) The post mortem was conducted at about 11.30 a.m. at the All India Institute of Medical Sciences on the same day *i.e.* 30.04.1999. In the meantime, at about 11.00 a.m., SI Pankaj Malik (PW-85) had been sent to Chandigarh to secure the black Tata Safari and to arrest the appellant. PW-100 corded the statements of the witnesses. On 30.04.1999 at about 4.15 p.m., an FIR was registered against Malini Ramani (PW-6), Beena Ramani (PW-20) and George Mailhot (PW-24) under sections 61/68/1/14 of the Punjab Excise Act. At about 8.30 p.m., PW-100 handed over the investigation to SHO S.K. Sharma (PW-101). On the night intervening 30.04.1999/01.05.1999, at about 2 a.m., the police raided the farm house of the appellant and on search being conducted seized a photograph of the appellant. On 02.05.1999, a list of invited guests was prepared by PW-24. On the same day, around 10.00 p.m., PW-101, got an information that a black Tata Safari has been found by the U.P. Police (Sector 24, Noida Police Station) and on the next day PW-101 went to Noida Police Station and seized the said black Tata Safari. On 05.05.1999 at about 2.30 a.m., Amardeep Singh Gill @ Tony Gill and Alok Khanna were arrested and from their alleged disclosure statements, the involvement of Sidhartha Vashisht @ Manu Sharma was confirmed. On the same day, Inspector Raman Lamba (PW 87) who was in Chandigarh with his team intimated the lawyer of the accused-appellant that Manu Sharma is required in the case. On receipt of the information, on 06.05.1999, the appellant surrendered before PW-87 and was later arrested at about 2.20 p.m. and brought to Delhi. On 07.05.1999, the police produced the appellant before the Metropolitan Magistrate and sought police remand for effecting recovery of the alleged weapon of offence. An application for conducting Test Identification Parade (TIP) of the appellant was also moved. Thereafter, the appellant was remanded to five days police custody till 12.05.1999 and thereafter on 12.05.1999 extended till 17.05.1999 on the application of the I.O., but on 15.05.1999, the appellant's remand was preponed from 17.05.1999 to 15.05.1999. On 16.05.99, the appellant was sent to judicial custody. On 30.05.1999, the accused-Vikas Yadav was also arrested. After the completion of investigation, the other accused persons were also arrested.

(d) On 03.08.1999, charge sheet was filed against ten accused persons. On 23.11.2000, the Additional Sessions Judge framed charges against the appellant/Manu Sharma under sections 302, 201 read with 120B, IPC and section 27 of the Arms Act, accused Amardeep Singh Gill was charged under section 120 read with section 201, IPC, accused Vikas Yadav was charged under section 120 read with 201, IPC as also section 201 read with 34, IPC, accused Harvinder Chopra, Vikas Gill, Yograj Singh and Raja Chopra under section 212, IPC and accused Alok Khanna, Shyam Sunder Sharma and Amit Jhingan were discharged of all the offences. In 2000/2001, Revision Petition No. 596 of 2000 was preferred by the prosecution before the High Court of Delhi praying for

the framing of charge against the accused persons and setting aside the discharge of Alok Khanna, Shyam Sunder Sharma and Amit Jhingan. Revision Petitions were also preferred by the accused persons against the framing of the charges against them. The High Court disposed of all the revision petitions filed by the accused persons by a common order dated 13.03.2001. On 12.04.2001, charges as per the orders of the High Court were framed and some of the charges as framed earlier were maintained. Charges under section 120B/201, IPC were framed against accused Vikas Yadav, Amardeep Singh Gill @ Tony Gill and Alok Khanna and charges under sections 201 and 212, IPC were framed against accused Shyam Sunder Sharma. Against the rest of the accused, the charges as framed on 23.11.2000 by the trial Court were maintained. Trial began in May, 2001 against nine accused. In all, 101 witnesses were examined by the prosecution and two court witnesses were also examined.

(e) On 28.01.2002, the appellant was released on interim bail for a period of six weeks by the order of the High Court dated 25.01.2002 with a direction to surrender after the expiry of the same. In compliance with the conditions of interim bail, the appellant surrendered on 11.3.2002 but again sought for and granted interim bail for a period of ten weeks starting from 20.03.2002. During the period from March 2002 to February 2006, the appellant was enlarged on bail on different occasions by various orders of the High Court. On one occasion, against the dismissal of the bail application by the High Court on 11.11.2003, the appellant filed a special leave petition before this Court which was dismissed by this Court on 02.12.2003. On 21.02.2006, after trial, the Additional Sessions Judge acquitted all the nine accused including the appellant-Manu Sharma.

(f) Challenging the acquittal, the prosecution filed an appeal before the High Court, being Crl. Appeal No. 193 of 2006. On 20.12.2006, the High Court *vide* the impugned order, convicted and sentenced the appellants, as mentioned in paragraphs above. Challenging the said order of the High Court, all the three appellants filed above mentioned separate appeals before this Court. All the appeals were heard together and are being disposed of by this common judgment.

(64) The evidence in respect of two FSL reports is as under:

By letter dated 06.07.1999, the seized material was forwarded to CFSL for examination and expert opinion and, *inter alia*, the following queries were made to be opined by the CFSL:

"5. Please examined and opine whether the two empties present in parcel mentioned at Sl. No. 5 have been fired from the same weapon?

6. Please examine and opine whether the bullet lead in parcel No. 6 and the bullet empties in parcel No. 5 have been fired from a standard firearm or a country made firearm?

7. Please examine and opine whether ejector, trigger, chamber, magazine or other chamber marks are present on the live bullet empties contained in parcel Nos. 6 & 5 respectively?

8. If answer to query No. 7 is yes then whether these marks are similar and caused by the same firearm?"

The Ballistics Division of CFSL gave report in respect of the queries as under:

"(1) The .22" badly mutilated lead bullet (marked BC/1) of No. 3 could have been fired from a standard .22" caliber firearm.

(2) The two .22" cartridge cases marked C/1 and C/2 have been fired from two different .22" caliber standard firearms.

(3) The .22" cartridge (marked C/3) of parcel No. 5 is a live cartridge and no characteristic tool marks (i.e. firing pin, ejector, extractor, breech face, magazine or chamber marks etc.) could be observed on this cartridge.

(4) The two .22" cartridge cases (marked C/1 & C/2) of parcel No. 4 and the .22" cartridge (marked C/3) of parcel No. 5 have similar Head Stamp of 'C' indicating that they are of the same make. No opinion on their series (lot/ batch) could however be given."

According to the State the same also contained inconclusive opinion. It was pointed out that the State has neither relied on the report of the expert Sh. Rup Singh nor had filed it in the trial Court. An application was moved by the accused for the supply of the document and *vide* Order dated 14.01.2000, the Metropolitan Magistrate directed that the State will have to supply all the deficient copies and also the remaining CFSL reports sent by CFSL to SHO. The opinion of Sh. Rup Singh, Ballistic expert finally exhibited as Ex. PW 89/DB only says that "it appears that the two cartridge cases are from two different pistols." As rightly pointed out such a vague opinion of the expert can neither be relied upon nor can be any basis to come to a conclusion that there were two persons who had fired two different shots.

(65) With regard to Prem Sagar Manocha PW-95, Ballistic expert at FSL, Jaipur, a specific query being query No.3 that whether both the empty cartridge cases have been fired from the same firearm or otherwise. In the reply to the said query, the expert opined that no definite opinion could be given on the two .22" bore cartridge cases C-1 and C-2 in order to link with the firearm unless the suspected firearm is available to examination**.** It was pointed out that the trial Court puts a question to the witness and while putting the question first gives a specific fact finding that for reply to Query No. 3, the presence of the firearm was not necessary. This incorrect finding of fact given by the trial Court based on no expertise and had resulted in grave miscarriage of justice. It is well settled that while giving reports after Ballistic examination, the bullets, cartridge case and the cartridges recovered and weapon of offence recovered are carefully examined and test firing is done at the FSL by the said weapon of offence and then only a specific opinion is given.

(66) It is contended by the learned counsel for the appellant/Manu Sharma that the prosecution tried their level best to suppress the report of the Ballistic expert Shri Rup Singh which was not favourable to them and that the same was exhibited at the instance of the defence as Ex. PW 89/DB. It has been further argued that while the charge sheet was filed on 03.08.1999, the police sought an expert opinion practically at the end of the investigation *i.e. vide* letter dated 16.07.1999, Ex. PW-89/DA. At Sl. No. 67 of the charge sheet one finds mention of the letters sent by the SHO seeking the expert opinion. The charge sheet was filed without the expert opinion. The accused on seeing Sl. No.67, approached the committal Court and asked for the expert report. It has been argued that the I.O. had received the opinion in the first week of December, 1999 but did not file the same. On 21.12.1999, the Court directed the prosecution to file the report. The SPP objected to the same on the ground that the order required modification but the same was rejected and on 14.01.2000, the Court again directed supply of the expert report. It has been argued that since the report did not favour the prosecution, the same was withheld. It has been further argued by the defence that failure on the part of the prosecution to bring on record material which is in favour of the accused is a breach of Article 21 of the Constitution. It has been argued by the defence that it was improper on the part of the prosecution to condemn a ballistic expert, *i.e.*, Rup Singh without calling him in for cross-examination. It has been further argued by the defence that by virtue of section 293, Cr.P.C., the report is admissible in evidence and that the weapon is not required to show whether the two empties are fired from the same gun and the weapon is only required when one has to determine as to whether a particular weapon was responsible for firing the empties in question. The expert evidence is only good if it appeals to the judicial lines; appreciation of such evidence can only be the work of the Court. Reliance has been placed on *A.E.G. Carapiet* v. *A.Y. Derderian,* AIR 1961 Cal 359 paras 10-14 to assert that every witness must be cross-examined before being discredited. The prosecution cannot challenge the expert at the stage of appeal when his testimony went unchallenged at the stage of the trial.

(67) It has been argued that the Court must lay down in clear terms the duties of a public prosecutor *i.e.*, to tell the truth even if the same is in favour of the accused. Reliance has been placed on Rule 16 of the Bar Council of India Rules which are to the said effect. Reliance is further placed on Attorney Generals Guidelines contained in Archbold Criminal pleadings edition 2003 to say that it is obligatory on the part of the prosecution to disclose all the material. It has been argued that even after an application under section 391, Cr.P.C. has been filed, the prosecution still chose not to call the expert Rup Singh and cross-examine him. Ex.PW-89/DB supports PW-2 and vice versa, since his evidence is corroborated by the expert report. Attention of the Court was invited to the results of the examination. As regards the 2nd opinion given by PW-95, it has been argued that this court must assume that the prosecution sought a favourable opinion from the said witness. The said witness obliged them and created confusion by saying that no conclusive opinion can be given without examining the weapon in question.

(67) It was pointed out by the State that the said report of Rup Singh is inadmissible in law since it is a photocopy and, therefore, does not fall within the purview of a report in terms of section 293 of the Code. In other words, in terms of the relevant provisions of the Indian Evidence Act unless the original document is placed for the scrutiny of the Court, no reliance can be placed on the photocopy without leading proper secondary evidence in this regard. In any case, both section 293 and section 294 of the Code which dispense with formal proof of documents under certain circumstances make it abundantly clear that the documents sought to be relied upon must be the originals.

1. Assuming for the sake of the argument, though not admitting, that the said report of Rup Singh, *i.e.* Ex. PW-89/DB is admissible even though a photocopy has been placed on record and even though nowhere it has come in evidence that the same *i.e.* the photocopy has been compared and scrutinized with the original by the Court and then placed on record, the same still loses all credence in the light of the fact that a perusal of the forwarding letter and report would show that there seems to have been some tampering with the said documents since the sequence of numbering of the parcels as between the forwarding letter and the report has been changed by somebody which fact remains unexplained as, therefore, casts a further doubt on the genuineness of the said report. The report itself with regard to query No. 3 shows that "it appears that the two cartridge cases C-1 and C-2 have been fired by two different weapons". This opinion of the expert was vague and on the basis of said opinion no credence can be lent to the fact adverted to by the defence that there were two persons who fired two different shots from two different weapons. Moreover the said report is oddly silent on query No. 7 of the forwarding letter wherein it was specifically asked about the various markings on the *live* cartridge and the bullet empties.

The stand of the defence that to opine the two cartridge cases are from the same weapon or not the pistol is not required and the pistol is only required when the opinion is sought whether they are from that particular weapon or not cannot be accepted. It is well settled that when pressure is built inside the cartridge case, which results in the pushing out of the bullet from the barrel, there is difference in the marks to the extent that it may be either clear or unclear and flattened or deepened thus no opinion can be rendered on account of this dissimilarity in the absence of the weapon of offence and test firing[1].

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1. The stand taken by the court in unfortunate. The defence failed to provide data contrary to the stand. Two cartrides can be identified/discriminated whether they had been fired from one or two firearms without the availability of the firearms.

   Normally two fired cartridges can be identified whether they had been fired from the same firearm or from different firearms; as the marks left by a particular firearm are unique and individual to that firearm. The firearms are not needed to ascertain the factum whether one or two firearms were used. The modern NIBIN **(Automatic Comparison Systems)** does not require firearm(s) for the identification at all. Previously fired cartridge(s) are used for comparison/evaluation. There is ample support for the proposition in literature: See: Sharma, BR Firearms in Criminal Investigation and Trials, IV Ed. Pages; 189, 198, 207. Only in rare cases differentiation is not possible when the marks of the firearm are not printed properly or they are mutilated. **(Author's Note).**

Further once the report of Rup Singh is rendered inadmissible the two gun theory of the defence becomes wholly inadmissible and what remains is that the two empties found at the spot are .22" bore cartridges, that the live bullet found in the Tata Safari is a .22" cartridge and that the gun belonging to the appellant is a .22" bore pistol which was used for the commission of the crime of murder of Jessica Lal.

(68) The prosecution obtained another opinion from FSL Rajasthan and the queries made are as under:

"1. Please examine and opine the bore of the two empty cartridges present in the sealed parcel.

2. Please opine whether these two empty cartridges have been fired from a pistol or a revolver.

3. Whether both the empty cartridges have been fired from the same fire arm or otherwise."

In response to these queries, the expert opinion of the FSL, Rajasthan is as under:

"1. The caliber of two cartridge cases (C/1 and C/2) is .22.

2. These two cartridge cases (C/1 and C/2) appear to have been fired from a pistol.

3. No definite opinion could be given on two .22 cartridge cases (C/1 and C/2) in order to link with firearm unless the suspected firearm is available for examination."

It was pointed out by the State that this opinion also was inconclusive in nature. In the worksheet, it was categorically recorded that the Investigating Officer be informed to make available the suspected firearm used for definite opinion on linking of C-1 and C-2 with the same firearm or otherwise. The worksheet also records that the firearm involved be sent for definite opinion. At this juncture, it is relevant to note that the trial Court posed a leading question as under:

"Q. From reply to query No.3 the presence of the firearm was not necessary. The question was whether the two empty cartridges have been fired from one instrument or from different instruments?

Ans. The question is now clear to me. I can answer the query here and now. These two cartridge cases were examined physically and under stereo and comparison microscopes to study and observe and compare the evidence and the characteristics marks present on them which have been printed during firing. After comparison, I am of the opinion that these two cartridge cases C/1 and C/2 appeared to have been fired from two different firearms."

The said witness in further cross-examination replied as under:

"There is nothing in the record of the Court on my report on the basis of which I had given this finding that C/1 and C/2 were fired from two different firearms"

The said witness in further cross-examination deposes that no photographs were taken or there is any other evidence to show the basis of opinion given by the witness before the trial Court.

(69) The learned senior counsel for the appellant-accused has contended that the contention of the prosecution that the trial Court could not have asked the particular Court question to PW-95 is contrary to section 165, Cr.P.C. inasmuch as the power of Judge is very wide. It has been further argued by the defence that the duties of a Presiding officer are set out in section 165 of the Indian Evidence Act. Reliance is sought to be placed on *Ram Chander* v. *State of Haryana*, AIR 1981 SC 1036. It has been argued that the judge knew that the issue was whether two empties were fired from the same gun. It has been further argued that the judge has seen EX. PW-89/DB and, therefore, any judge would have noticed that the controversy was whether these two bullets were fired from the same weapon or not. The Judge also found out that this query went to the CFSL and CFSL answered the same. It has been argued that, therefore, the Judge knew that to answer this query weapon was not required. It has been argued that the Court must read in between the lines.

(70) It is pointed out by the State that the contention of the prosecution was that the trial Court could not have first put a specific finding of its own opinion to the expert witness and then to ask him questions. Learned Solicitor General pointed out that in the attempt of the trial Court to extract the truth from the said witness, it misdirected itself in law by posing such a question. This is impermissible even as per the judgment in *Ram Chander* (supra) relied on by the defence. This judgment is in fact in favour of the prosecution since the same clearly puts an embargo on the power of a judge to ask questions so as to frighten, coerce, confuse or intimidate the witness. The danger inherent in a judge adopting a much too stern an attitude towards witness has been duly explained in the said decision. The judge cannot ask questions which may confuse a witness. The argument that the judge knew that the issue in question was whether the two empties found on the spot were fired from the same gun is wrong and misleading. The judge knew that as per the charge framed against Manu Sharma it was he alone who was charged with the possession and use of a gun. The judge also knew that the first expert opinion was brought on record at the instance of the accused; the judge further knew that PW-95 had stated in no uncertain terms that no opinion can be given as regards the two empties without receipt of the weapon of offence**.**

In spite of knowing all this, the judge first put a finding of its own to the witness that he did not need the firearm in question in order to reply as to whether the two empties were fired from the same gun i.e., a gun and not the gun. The Court exceeded its power under section 165 of the Evidence Act by putting the question after giving its own finding.

(71) On behalf of the prosecution, it is pointed out that the entire argument of the accused that an expert opinion was sought at the fag end of the charge sheet to seek a favourable opinion in favour of the prosecution in fact suggests that the I.O. in question was oblivious of the fact that such an opinion could

work to the detriment of the case of the prosecution *i.e.* two empties having been fired from the same weapon of offence belonging to accused Manu Sharma. The fact that the I.O. sought to mention at S. No. 67 of the list of documents in the Charge Sheet about the forwarding letter to the expert only suggests that the prosecution had no intention of carrying out the act of seeking an expert opinion, is hiding. The discretion on the part of the I.O. and the superior officers was rightly exercised when they decided not to file the expert report since they realized that the expert report is ambiguous as it uses the term "appear" when it suggests that the two empties appear to have been fired from different weapons. Clearly the said opinion was far from conclusive and would have only created confusion in the case of the prosecution. Thereafter a second opinion was sought wherein the expert *i.e.* PW-95 opined that a conclusive opinion can only be given after the receipt of the weapon of offence. The argument that the weapon of offence is not required to determine whether the two bullets have been fired from the same gun is based on the wrong premise that the two empties would necessarily consist of features which would enable an expert in determining the said fact. For instance, as in the case of a handwriting expert who has to give an opinion about two different sets of near identical questioned documents and as to whether the same belong to different persons, if the argument of the accused has to be accepted then the expert should be able to give such an opinion without having in his possession the specimen handwriting and the admitted handwriting of the accused. It is stated that such an approach would render the opinion as that of a layman and not an expert. Similar would be case of a finger print expert who undertakes the process of discovering two different sets of finger print which are in question, without having the specimen or the admitted finger print of the accused in question.

In other words, an expert is only an expert if he follows the well accepted guidelines to arrive at a conclusion and supports the same with logical reasoning which is a requirement of law as laid down in the Indian Evidence Act.

In the present case, the moment Rup Singh uses the word "appear" his opinion unsupported by reasons becomes inconclusive and stands discredited for the purpose of placing reliance on. The opinion of Rup Singh was at query No.7 as to "please examine and opine whether ejector, trigger, chamber, magazine or other tool marks are present on the live bullet and the bullet empties contained in parcel Nos. 6 & 5 respectively." Though Shri Rup Singh has given opinion qua query No.5 that the two .22" cartridge cases appears to have been fired from two different .22" caliber standard firearms but his opinion is completely silent on the marks *i.e.* ejector, trigger, chamber, magazine or other tool marks on the bullet empties (Ex. PW 89/DB)[1]. Clearly an option was available to the accused under section 293 Cr.P.C. to call for the witness and ascertain from him for sure that the two empties were in fact fire from two different weapons, however, the accused did not choose to do so in terms of section 293 Cr.P.C. In any case, the opinion of Rup Singh as of today is of little use to the accused for the reasons stated above and since it is both inconclusive and unsupported by any reasoning

1. These marks are routinely examined to ascertain linkage/de-linkage of the arm and fired cartridges. Separate mention is not called for. **(Author's Note).**

whatsoever and, therefore, cannot appeal to the judicial mind of this Court. Similar is the case with the expert opinion of PW-95 which is again inconclusive. There is no evidence on record to suggest that PW-95 gave an opinion to oblige the prosecution. On the contrary, his response to the Court question reveals that he was extremely confused as to the issue which had to be addressed by him in the capacity of an expert. In the concluding part of his testimony he reaffirms the opinion given by him which is that without test firing the empties from the weapon of offence no conclusive opinion can be given.

(72) It is pertinent to note that the testimony of the experts *i.e.*, Rup Singh exhibited as Ex.PW-89/DB and PW-95 Prem Sagar Minocha exhibited as Wx PW-95/C-1 in inconclusive. The expert PW-95 Prem Sagar Minocha has stated in his report that it is only on receiving the weapon of offence that a conclusive opinion as to whether the two empties (cartridge cases) found at the spot were fired from the same weapon or from two different weapons could be given.

(73) The defence seeks to reply upon the testimony of PW-2 with regard to the two gun theory put forward. In this regard, the defence seeks to corroborate the said part of PW-2's testimony with the testimony of the two ballistic experts. It has also been contended by the defence that the testimony of a hostile witness must be corroborated by the other reliable evidence on record in order to be admissible. The law is very clear that where a witness for the prosecution turns hostile, the Court may rely upon so much of the testimony, which supports the case of the prosecution and is corroborated by other evidence. PW-2's testimony as regards the identity of the person shooting, is certainly not corroborated by the testimony of the experts since both the experts have given opinions which cannot qualify as conclusive opinion of experts.

1.2 Fake Injuries: No Pellets![1]

Brief facts which are necessary to dispose of this appeal are recapitulated as under:—

The dispute is between very close and intimate family members. Deceased Gurcharan Singh was the brother of Bakhtawar Singh and uncle of Darshan Singh. He was the father of Gurdish Singh, PW7, the informant. The agriculture fields of both brothers, Gurcharan Singh and Bakhtawar Singh were situated adjoining to each other.

According to the prosecution, on 15.7.1991 at about 8 a.m. Gurdish Singh, PW7 and his father, Gurcharan Singh were irrigating their aforesaid fields and were also mending its ridges and at that time Gurdev Singh, PW8 and Ajit Singh were also present there. In the meantime, Darshan Singh and Bakhtawar Singh came there from the side of their fields raising lalkaras and abused the complainant party. Darshan Singh, accused was armed with D.B.B.L. gun and his father Bakhtawar Singh was carrying a Gandasa and they were saying that they would teach a lesson to the complainant party for cutting the ridges.

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1. *Darshan Singh* v. *State of Punjab,* (2010) 1 SCR 642.

5. According to the further story of the prosecution, Bakhtawar Singh gave a Gandasa blow causing injuries on the chest of Gurcharan Singh. Gurcharan Singh was also having a Gandasa with him and in order to save himself he also caused injury on the head of Bakhtawar Singh. Thereafter, Darshan Singh fired two shots from his licensed gun which hit Gurcharan Singh in the chest and some of the pellets hit Gurdish Singh PW7 on his left upper arm and Gurdev Singh, PW8 on his left thigh. Gurcharan Singh fell down and died at the spot. Gurdish Singh and others retraced their steps in order to save themselves. Both the accused in order to save themselves ran towards their respective houses. The prosecution examined 11 witnesses. Dr. Mukesh Gupta, PW4 who conducted the post-mortem examination found the following injuries on the dead body of Gurcharan Singh:—

"1. There were 14 wounds in an area of 20 cm x 18 cm on left side of the chest above the nipple. One of the wounds which was above the nipple was having inverted margins. A wad was recovered from this wound. This wound was 1 cm x 1 cm. The 9 wounds which measured 0.75 cm x 0.75 cm which were on the chest and shoulder also had Inverted margins. Out of these wounds 6 were found to entering chest cavity and 6 pellets were recovered from the chest cavity. The remaining 3 wounds were having everted margins. These were near the axilla and each wound measured 1 cm x 1 cm. One of the 14 wounds which measured 0.75 cm x 1.5 cm was having inverted margins. It was skin deep and was on the shoulder, upper part of humerous and clavicle bones were found to be fractured. 4th and 5th rib of the left side of the chest were also found to be fractured.

2. There were 7 wounds in an area of 20 cm x 8 cm on the upper part of the chest on its right side above the nipple. Out of these wounds 3 wounds measuring 0.75 cm x 1 cm each was having inverted margins, these were skin deep. 2 wounds were having everted margins having a dimension of 1 x 1 cm each near the axilla. A pellet was recovered from near the axilla. The remaining 2 wounds were near the top of right shoulder measuring 0.75 x 1.5 cm each with inverted margins. These were skin deep.

3. An incised wound 8 cm x 0.5 cm skin deep on the left side of chest 3 cm above the nipple. It was horizontally placed."

10. Dr. Mukesh Gupta found following injury on the person of Gurdev Singh:—

"An abrasion measuring 1 cm x 0.5 cm on the front and inner side of left thigh. It was a superficial abrasion reddish in colour, over the junction of upper 1/3rd and lower 2/3rd of the thigh. There was damage to the pajama corresponding to the injury."

11. According to the doctor, the injury was simple in nature and was caused within 24 hours. Doctor also found injury on Gurdish Singh to be superficial. The same reads as under:—

"A very superficial abrasion 1 cm x 0.5 cm on the upper side of left upper arm 12 cm above the elbow. It was reddish in colour."

12. It may be relevant to mention that Dr. M.S. Gill, PW5, who conducted the medical examination of Bakhtawar Singh found the following injuries on his person:—

> *"1. An incised wound 7 cm x 0.5 cm on the parietal region of the right side of head. It was placed anterior posteriorly. The wound was bone deep and 4 cm above the right pinna lotted blood was present."*

13. According to doctor, this injury was caused by sharp-edged weapon.

* * * * *

18. The trial court after discussing the entire evidence came to the conclusion that two counter versions of the case have been presented and, in the view of the trial court, the defence version is more probable and nearer to the truth for the following reasons:

(i) The delay in lodging the FIR impels the court to scrutinize the evidence of witnesses regarding the actual occurrence with greater care and caution.

(ii) The crucial point to be decided in this case was that who was the aggressor or which of the parties can have the motive to open the attack?

The trial court held that "if the accused were already cultivating the land as per compromise, then it does not appeal to reason as to why they would feel aggrieved. On the other hand there was strong motive for Gurcharan Singh to assault the accused person as he has resiled from the compromise."

(iii) The next crucial point according to the trial court was as to where the incident took place? According to the trial court the incident had taken place in the field of the accused.

(iv) According to the trial court, the presence of the prosecution witnesses Gurdev Singh and Gurdish Singh at the time of alleged occurrence is highly doubtful.

Dr. Mukesh Gupta stated that the injuries on Gurdev Singh and Gurdish Singh could be caused by friendly hands and can be self suffered.

(v) No pellet was recovered from the injuries of the prosecution witnesses namely, Gurdev Singh and Gurdish Singh. The possibility of the injuries on their persons having been fabricated at a later stage cannot be ruled out.

The trial court found that, in the instant case, it appeared that the inquest report was prepared first and the FIR was prepared at some later stage because there was no mention about the injuries of Gurdev Singh and Gurdish Singh in the inquest report, whereas this fact is mentioned in the FIR. According to the prosecution case, Gurdish Singh suffered a pellet injury on his left upper arm whereas, Gurdev Singh was hit on his left thigh. This was so mentioned in the FIR. If it was so, this fact would have been mentioned in the inquest report or the

Investigating Officer must have prepared their injury statement, but no such injury statement was prepared at the spot nor their medical examination was got done.

In the cross-examination, Om Prakash ASI had admitted that he came to know about the injuries of Gurdish Singh and Gurdev Singh only when they gave their supplementary statements at the bus stand. The finding of the trial court is that the injuries were fabricated with the connivance of the Investigating Officer just in order to make Gurdish Singh and Gurdev Singh stamp witnesses.

(vi) Gurdish Singh P.W. 7 had admitted that his father Gurcharan Singh was face to face when Bakhtawar Singh gave Gandasa blow from above to downward vertically on the chest of Gurcharan Singh. However, Dr. Mukesh Gupta contradicted him and stated that injury No. 3 on the person of Gurcharan Singh was skin deep and was horizontally placed and was possible by a fall on a sharp edged weapon.

From this it can safely be concluded that it was not Bakhtawar Singh who gave Gandasa blow to Gurcharan Singh in the manner as suggested by the prosecution. It is most likely that Gurcharan Singh suffered injury No. 3 by a fall on his own Gandasa and this was the reason that the wound was only skin deep.

The story put forth by the prosecution that Gurcharan Singh was cutting weeds of ridges with Gandasa is not believable. Gurdish Singh stated that he was collecting the cut weeds.

They were not having any Kassi or Khurpa and it was not possible to cut weeds of ridges with Gandasa.

(vii) The trial court came to a clear conclusion that Bakhtawar Singh was injured at point 'F' as shown in the site plan at the hands of Gurcharan Singh (deceased). Gurcharan Singh after causing that injury forwarded towards Darshan Singh armed with Gandasa and at that point Darshan Singh had no option but to open fire and Gurcharan Singh died of that firearm injury. The trial court came to the definite conclusion that Darshan Singh fired a shot in his right of private defence.

(viii) The trial court after marshalling the entire evidence came to the conclusion that seeing from all angles, the probabilities of the case are much more in favour of the defence than in favour of the prosecution.

The possibility of the injuries having been caused to Gurcharan Singh by Darshan Singh in exercise of private defence cannot be ruled out. Thus, the prosecution has failed to prove its case against the accused person beyond any reasonable doubt and the benefit has to be given to them.

58. The following principles (for self defence) emerge on scrutiny of the judgments:

(i) Self-preservation is the basic human instinct and is duly recognized by the criminal jurisprudence of all civilized countries. All free, democratic

and civilized countries recognize the right of private defence within certain reasonable limits.

(ii) The right of private defence is available only to one who is suddenly confronted with the necessity of averting an impending danger and not of self-creation.

(iii) A mere reasonable apprehension is enough to put the right of self defence into operation. In other words, it is not necessary that there should be an actual commission of the offence in order to give rise to the right of private defence. It is enough if the accused apprehended that such an offence is contemplated and it is likely to be committed if the right of private defence is not exercised.

(iv) The right of private defence commences as soon as a reasonable apprehension arises and it is co-terminus with the duration of such apprehension.

(v) It is unrealistic to expect a person under assault to modulate his defence step by step with any arithmetical exactitude.

(vi) In private defence the force used by the accused ought not to be wholly is proportionate or much greater than necessary for protection of the person or property.

(vii) It is well settled that even if the accused does not plead self-defence, it is open to consider such a plea if the same arises from the material on record.

(viii) The accused need not prove the existence of the right of private defence beyond reasonable doubt.

(ix) The Indian Penal Code confers the right of private defence only when that unlawful or wrongful act is an offence.

(x) A person who is in imminent and reasonable danger of losing his life or limb may in exercise of self defence inflict any harm even extending to death on his assailant either when the assault is attempted or directly threatened.

In the instant case after marshalling and scrutinizing the entire prosecution evidence, we are clearly of the view that the trial court's view is not only the possible or plausible view but it is based on the correct analysis and evaluation of the entire evidence on record. Rationally speaking, no other view is legally possible.

65. Consequently, this appeal is allowed and the impugned judgment of the High Court is set aside and the judgment of acquittal of the trial court is restored. The role attributed to the appellant is fully covered by his right of private defence.

1.3 Firearm Evidence Ignored[1]

As per the prosecution, A-1, A-2, A-3 & A-6 had paid money to A-4 and A-5 for killing the deceased and pursuant thereto A-4 and A-5 had shot the

1. *Musheer Khan @ Badshah Khan* v. *State of Madhya Pradesh*, AIR 2010 SC 762.

deceased from a close range. A-4 & A-5 were arrested by the Jabalpur police at Ahmedabad. According to the prosecution A-4 & A-5 were seen before the occurrence in the company of A-1, A-2, A-3, A-6 & A-7 and after the occurrence, they were seen by other witnesses, namely, PWs 3 & 4 as going away from the scene of occurrence on a light blue coloured scooter along with the absconding accused Mehfooz (A-7). According to prosecution A-4 and A-5 were identified by witnesses in the T.I. Parade, their fingerprints were found on the car and on the recovered scooter. They had suffered a disclosure statement and which had resulted in discovery of the weapon of assault and the Ballistic Expert, had given the report, according to which it was proved that weapon of assault recovered from the Appellants had been used.

The prosecution version as unfolded in the case is that on 29.11.2000 around 7:10 P.M. one Pappu @ Prakash Tripathi (PW-3) was in his apartment. Then on hearing the firing of three shots, he came out of his apartment and saw a light blue coloured scooter, which was parked in front of the apartment, was being started by a man and after him two other persons also boarded that scooter. PW-3 also saw a Matiz car which was parked by the side of the road and he saw the body of Mallu Bhaiya, the deceased, half inside the car and the other half was lying outside the same. PW-3 further saw that after starting the scooter, those persons drove it towards the road and took a turn to the right and drove towards the side of Dainik Bhaskar Press. PW-3 further deposed that at the time those persons left in the scooter they were "turning their heads back". Then PW-3 came outside his apartment and started shouting.

3. The further evidence of PW-3 is that he immediately ran towards the deceased and found there was no movement in the body. On hearing the shots and the shouts of PW-3, the nearby cable operator Brajendra Keshwani (PW-17), Umesh Singh (PW-2) and one Gopal Jain (not examined by the prosecution) came to the place of incident. Then PW-3 with the help of those persons put the deceased on the back seat of that Matiz car. PW-3 drove that car with PW-2 in the front seat to Marble Hospital and PW-3 got the report written in the hospital which is marked Exhibit P-11.

69. The limited nature of the admissibility of the facts discovered pursuant to the statement of the accused under section 27 can be illustrated by the following example: Suppose a person accused of murder deposes to the police officer the fact as a result of which the weapon with which the crime is committed is discovered, but as a result of such discovery no inference can be drawn against the accused, if there is no evidence connecting the knife (weapon) with the crime alleged to have been committed by the accused.

70. So the objection of the defence counsel to the discovery made by the prosecution in this case cannot be sustained. But the discovery by itself does not help the prosecution to sustain the conviction and sentence imposed on A-4 and A-5.

1.4 Recovery Alone: No Evidence[1]

12. It is further clear that the recovery was not made from the residential portion but from the place where cattle are tied and the fodder is kept. The

1. *K. Thimma Reddi (in re:)*, 1957 Cr LJ 1091 (AP): AIR 1957 AP 758.

object was admittedly hidden from human gaze. The accused has farm-servants. It cannot be presumed that the place is not accessible to these farm-servants especially when it is a place for tying cattle. The exact location and its distance from the gate are not clear from the record. Under these circumstances, it cannot be held that the thing hidden at a place accessible to others in the house inhabited not only by A-I but also by another was in the conscious or voluntary possession of accused.

It was the duty of the prosecution to prove against the accused that M.O. 2 belonged to him, that he had secreted it or that he was in actual possession of the thing recovered. Mere physical presence of the accused in proximity to the object cannot by itself be an incriminating circumstance unless it can be held that he was in conscious and intelligent possession of that object. Merely because he is the head of the joint family or the owner of the house, he cannot be credited with constructive knowledge of a hidden thing. Possession must imply knowledge and there would be no possession when there is no knowledge.

It requires no elaborate argument to state that possession without knowledge lacks the element of *mens rea* or criminal intention, which is essential for an offence. It cannot also be said that the weapon was under the control of the accused within the meaning of the Arms Act. "Control" under the Arms Act means that the accused must have power over the weapon so that he can direct its custody, production, use or disposal in some manner. Thus, in the instant case, it cannot be held that the said country-made smooth bore firearm which was lying buried in the manger at a place accessible to others was in the conscious or voluntary possession and control of the first accused. The offence under section 19(f) of Arms Act, is not, therefore, made out against him.

14. The prosecution has relied on the report of the Chemical Examiner and the expert evidence of P.W. 38. The report of the Chemical Examiner is to the effect that the barrel washings of the pistol (M.O. 2) were examined and the combustion products of the smokeless powder in them were detected, though the time of firing could not be stated. The Chemical Examiner has further stated that he examined the margins of the rents of item X and the scrapings from item XIII for products of combustion of gunpowder but he did not detect the products of combustion of gunpowder in either various items with the assistance of the firearm expert of the Crime Branch C.I.D., Madras are that:—

(i) Item XII (M.O. 2) is a country-made pistol capable of firing a 12 bore cartridge and is in working order.

(ii) M.O. 7 was fired from M.O. 2.

(iii) M.Os. 8 to 10 could have formed part of 6 size 12 bore cartridge like M.O. 7 and could have been discharged from the same; and that

(iv) The pellets recovered are of No. 6 size and the pistol was discharged from a distance of 6 feet which can be concluded, having regard to the injuries described in the post-mortem certificate.

15. P.W. 38 in his deposition states that he fired a test cartridge with M.O. 2 and compared the pin-mark on M.O. 7 with the aid of a comparison microscope and he found agreement in shape and other finer striations and, therefore, he

was of opinion that M.O. 7 was fired from M.O. 2. As regards M.Os. 8, 9 and 10 he states that they could have formed part of M.O. 7 and could have been discharged from it. He further states that the barrel washing of M.O. 2 was taken and the combustion products of smokeless powder were found but the exact time of firing could not be stated. In cross-examination he says he did not take any photos of the pin-points etc. that a similar cartridge like M.O. 7 could be fired in a revolver of the same bore, even if hand-made, will have its own individual characteristics, in casting the pin-marks.

16. In scientific criminology the main principle of forensic ballistic is to establish whether a given bullet or cartridge was used in a particular weapon. The scientific knowledge during the past thirty years in this regard has advanced considerably. It is now possible not only to tally the cartridge fired with the gun used but a number of other important facts can be decided though with varying degrees of probability. Among these are the distance from which a shot was fired, the approximate time when the weapon was last fired and other questions of similar nature. These are all the questions that require solution in the present case. As pointed out above, the cartridge was not found at the place of occurrence. But, it was at altogether a different place.

It is necessary that it should be first connected with the pellets that were ejected and then with the weapon that discharged the same. This is possible if not only the time of firing M.O. 2 tallies with the time of the incident but also the thumbprints of the gun on the cap and base of the cartridge tally with those found on the disputed cartridge and further the pellets are traced to the firearm in question. The conclusions of the firearms expert and the chemical examiner in this particular case do not take us far in the murder. So far as the pellets are concerned, the results arrived at by the firearms expert do not appear to be conclusive.

They only seem to bear the impress of a mere probability though with regard to the pin strike and finer striations on the base or the cap of the cartridge the opinion expressed seems to be definite and conclusive. But, unfortunately, he has not produced the test cartridge for comparison purposes. The learned advocate on that account has argued that unless the data be supplied or the enlarged photos be produced so that the opinion of the expert may be verified by the court, the court ought not to accept the opinion of the expert without satisfying itself of the correctness of the same. Reliance has been placed in *Balija Pulayya (in re:)*, AIR 1941 Mad 88(I); *Harendranath Sen* v. *Emperor*, AIR 1931 Cal 441(J) and *Fakir Mohomed* v. *State of Madhya Pradesh*, 1967 Cr LJ 1197.

We feel that the test cartridge ought to have been sent to the court so that the court could be satisfied of the identity of the thumbprint of the gun on the breech face of both the cartridges.

As we have observed above, forensic ballistic concern with investigation of firearms and ammunition and of problems arising from their use for purposes of legal evidence. The firearms can be broadly divided into two main classes: (1) smooth bore arms; and (2) rifled arms. In the first comes the shotguns or the firearms like M.O. 2. M.O. 2 cannot be confused with an automatic or self-

loading pistol which ejects the empty cartridge at the spot nor with a revolver which has a rotating magazine called cylinder.

Whatever its size, M.O. 2 is only a smooth bore country-made firearm. The rifles, revolvers, automatic and self-loading pistols and machine guns fall under the above-mentioned second class. The barrel of the second class being furnished with spiral grooves imparts spin to the bullet, thereby giving not only accuracy and penetrating powder but also the markings and the other characteristics of the barrel which carry individual peculiarities.

But, shots discharged from a smooth bore firearm scatter over an area that increases roughly according to the distance of the target from the gun, and besides these missiles do not bear the individual characteristics of the barrel so effectively as in the rifled arm. That is the reason why the pellets from a shot-gun, though can be measured, weighed and subjected to chemical analysis, cannot establish the identity of the gun that fired them though in the case of bullets from a rifled arm the identification of bullets is possible with the help of a microscope and expert's services.

Lemoyne Synder in his book on *Homicide Investigation* at page 100 discussing the bullets from a rifled arm states as follows:—

> *When a lead bullet is fired through this barrel, these characteristics of the gun barrel will be transferred to the sides of the bullet so that bullets fired from a certain barrel will have characteristics which are peculiar to that particular firearm and to no other. In like manner other machine parts of the mechanism, such as the firing pin, extractor pins, the breech facing will likewise impart marks to the primer or shell which are characteristics of that particular weapon and to no other.*
>
> *Thus, it is possible, when a bullet is found, in a dead body or any empty shell near where a gun is fired, to tell whether that bullet or shell was fired in any particular weapon which may be suspected of having fired the fatal shot.*

C.J. Poison in *The Essentials of Forensic Medicine* at page 166 with regard to shotgun missiles states that:—

> *The pellets from a shotgun can be measured, weighed and subjected to chemical analysis, although the results have a relatively limited value.*

Thus, in this particular case where the pellets have been discharged from a smooth bore barrel firearm the expert's opinion cannot take us far. The pellets unlike the bullets do not bear the impress or the characteristic marks of the barrel of a particular weapon which distinguish them from those of the barrel of any other like weapon.

The size of the pellets alone is not a dependable test not when their actual number is not correctly ascertained can they be in any manner connected with M.O. 7 to any degree of probability or certainty. It must be remembered that even in cases of bullet evidence the expert evidence should come before the court by means of photomicrographs. Nigel Morland in *An Outline of Scientific Criminology* at page 96 under the caption "Court and Bullet Evidence" states:—

> *Expert evidence of the highly technical kind with forensic ballistics deals, is usually presented to the court by means of photomicrographs that show the various significant points of agreement. The preparation of these demands a high degree of skill if all the relevant points are to be brought out and the possibility of error executed. It is a tribute to the way in which such work has been handled that, new though forensic ballistics is as compared with other sciences, courts today readily accept its evidence.*

Thus, it is evident that the evidence with regard to identity of pellets not only labours under inherent want of precision but also is most unsatisfactory. The case of the prosecution that the missiles at the scene of occurrence were discharged from M.O. 2 must, therefore, fail. No doubt, the thumbprint of the gun on the cartridge plays an important part in establishing the identity of the gun provided the suspected cartridge can be connected with the incident, but in this regard too there is no material on record that the trial shots conducted have given the thumbprint of the gun in perfect unison with that on the suspected cartridge, M.O. 7. Lemoyne Synder on *Homicide Investigation* at page 100 while describing figures 32 explains the fired shell as follows:—

> *When a cartridge is fired the explosion not only forces the bullet out of the barrel, but with equal force it drives the shell back against the breech of the gun. The primer, being made of soft metal, will pick up any scratches or tool marks on the breech facing and these markings on the primer will be characteristic of that particular firearm and none other.*

Nigel Morland in his book on *An Outline of Scientific Criminology* at page 91 characterises these markings as thumbprint of the gun and describes them as below:—

> *When a firearm of any kind is discharged, the gases generated by the combustion of the charge have two effects, they eject the bullet from the muzzle with considerable velocity, and they drive back the cartridge against the breech face of the weapon. The pressure with which the latter occurs is sufficient to cause the cap and base of the cartridge, which are of comparatively soft metal, to take an imprint of the breech face, in much the same way as a piece of wax pressed on to a seal takes an impression of the design. It is this imprint which enables cartridges to be identified as to having been fired from a particular gun.*

While describing the method of examining cartridges, at page 92 he states as follows:—

> *Broadly, therefore, the method of determining whether a cartridge has been fired from a given gun—often an important factor in crime investigation—is as follows: Several trial shots are fired from the gun it is desired to test. The markings made on the cartridges are compared with those on the suspected cartridge.*
>
> *By a process of comparison and minute examination according to a fixed plan, identity can be established or disproved with a probability of error so remote as to be entirely outside practical consideration. To put the problem simply, it may be stated thus: the trial shots give the thumbprint of the gun. Has the suspected cartridge the same thumbprint? If it has, identity is established; if not, it is certain that the gun and the cartridge do not 'marry'.*

In practice, as would be expected, the matter is not so simple as this and many difficulties and complications arise. To start with not only the marks already mentioned on the base of the cartridge and on the cap, but those on the body, or tubular part, have to be considered. There are others that provide clues, such as the indentation made by the firing pin and by the mechanism for ejecting the spent cartridge. The pressure of the cases formed by the explosion also plays a part in determining the nature of the thumbprint, since, owning to slight differences in the charge as between cartridge and cartridge, certain marks may appear on one cartridge, and not on another. This makes it clear that even the examination of cartridges requires minute care and thorough satisfaction for correct conclusions. The court drawing an inference from the opinion of the expert, therefore, should be satisfied of all these.

17. This is possible only when the requisite material is brought before it. Evidently but for M.O. 7 which is said to be a suspected cartridge, no test cartridges has been produced before the court so that the identity of the marks on the suspected cartridge may be established with the test cartridge. Indubitably, the evidence on record is scanty and does not connect M.O. 2 either with M.O. 7 or with the pellets that were discharged at the place of occurrence. As we have pointed out above the expert has expressed his inability to determine even approximately the time at which the gun must have been last fired. The chemical examiner's conclusion with regard to the range of firing too based wholly on the injuries described in the post-mortem certificate is not much dependable.

The diameter of the area in which the pellets lay is not ascertained for any estimate is based on tests with the suspected weapon. The overshot card or wad may also be a determining factor. But evidently that has not been made the basis for his conclusion. We think it unnecessary to enter into a detailed discussion in this behalf. It is, however, clear that the evidence of the expert or the chemical examiner in this case is of no help in establishing the identity of the pellets with the gun, M.O. 2. Neither M.O. 2 nor M.O. 7 can, therefore, be said to be an incriminating object in relation to the murder of the deceased.

Thus, it is neither proved that A-4 or A-1 had owned or possessed M.O. 2 and M.O. 7 nor is it established that these were used for the murder of the deceased.

1.5 Mere Recovery of the Gun[1]

The learned Additional Government Advocate submitted that the recovery of the gun from the house of the accused is a circumstance which should be taken into consideration along with the previous enmity between the parties, which provides the motive. No doubt, the gun had been recovered from the house of the accused, as stated by PWs 6, 7 and 9. This gun was sent to the ballistics expert. But the pellets recovered were not sent to him. It has been mentioned in the report (Ext. 11) of the ballistics expert: "It is not possible to say when the gun was last used for firing as final products of residue have already been formed".

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1. *State of Orissa* v. *Chander Pentia,* 1981 Cr LJ 1060.

There is also no other evidence to show that the shot was fired from this particular gun. So without any convincing evidence that the gun was used by the accused, mere recovery of the gun will not in any way help the prosecution.

Where the accused found in possession of pistol with loaded cartridges with working conditions, he could be convicted even in absence of expert examination and though the police officers not cross-examined on such working conditions.[1]

1.6 Genuine Recovery[2]

Recovery of the seven empties on the next day *i.e.* May 3, 1973, the Sessions Judge has disbelieved this part of the case for most perfunctory and unconvincing reasons since these empties were not recovered at night although the Investigating Officer searched for the same in the light of the torch and lantern, their recovery in the day must be deemed to be a fabrication. We are unable to agree with this fallacious process of reasoning.

In these circumstances, therefore, the reasons given by the learned Sessions Judge do not appeal to us at all and the High Court was right in reversing the finding of fact which was both wrong and perverse. In this connection, the High Court in *Dipu* v. *State of Uttar Pradesh*, 1977 Cr LJ 1508 observed as follows:—

"We do not find any element of untruth in this or any fabrication in the recovery of seven empty cartridge shells by the Assistant Sub-Inspector Dev Dutt on the morning following the occurrence. The recovery of all the empty cartridge shells from two different places inspires confidence and we have no hesitation to accept this".

The recovery of these seven empties is mentioned in seizure memo. Ext. P.Y. and apart from P.W. 23, the Investigating Officer, the recovery has been proved also by P.W. 19 Gurdial Singh who is an eye-witness and who has also been held by the courts below to be an independent and disinterested witness. Both these witnesses have deposed on oath regarding the recovery of seven empties from the spot. Merely because other witnesses were not examined would be no ground to reject their evidence. We would, however, like to point out that in future the Investigating Officer should not associate any eye-witness with the recovery memos, because that partakes of an attempt to make the witness omnibus. For these reasons, the recovery of three empties on the night of May 2, 1973 and seven empties in the morning of May 3, 1973 has been established beyond reasonable doubt and we see no reason to distrust the credibility of Exts. P.K.K. and P.Y. The recovery of the empties is a very important circumstance which fully corroborates the evidence of the eye-witnesses, taken alongwith the evidence of the ballistics expert that some of these empties could have been fired from the guns sent to him.

1.7 Manipulation not possible[3]

It has next been argued that the evidence regarding the recovery of the fired cartridge from the place of occurrence is unreliable because while two separate

1. *Harnek Singh* v. *State of Punjab*, AIR 1999 SC 316; *see* also *Sans Pal Singh* v. *State of Delhi*, AIR 1999 SC 49.
2. *Narpal Singh* v. *State of Haryana*, 1977 Cr LJ 642 (SC).
3. *Kartar Singh* v. *State of Punjab,* 1977 Cr LJ 214: AIR 1977 SC 349.

memoranda were prepared, one for the 11 fired cartridge cases of 12 bore guns and another for the two brass fired cartridge cases of the rifle, only one parcel was sent to the ballistics expert.

A reading of the statement of J.K. Sinha (P.W. 14), who is the Assistant Director of the Forensic Science Laboratory, Chandigarh, shows that one sealed parcel was received in the Laboratory on January 3, 1972, through constable Ujagar Singh, and it contained eleven 12 bore fired cartridge cases and two .315 fired cartridge cases. The statement of the witness in regard to the delivery of the sealed parcel in the Laboratory on January 3, 1972 has not been challenged before us, and there is no doubt that all the 13 fired cartridge cases reached the Forensic Science Laboratory of January 3, 1972. As none of the accused had been arrested by that time, and as no firearm had been recovered till then, the investigating officer had nothing to gain by tampering with the fired cartridge cases for he was not in possession of the firearms with reference to which they were to be tested in the laboratory. For the same reasons, the prosecution had nothing to gain by falsely showing the recovery of the brass fired cartridge cases, for it was found in the forensic laboratory that they had been fired from Darshan Singh's rifle Ex. P. 18 which was recovered only on January 10, 1972.

It was, therefore, not possible for the prosecution to plant them at the scene of occurrence on December 31, 1971 when it had no reason to think that Darshan Singh would be arrested some 10 days later with the rifle from which those cartridges had been fired.

1.8 Safe Custody[1]

After having been taken through the evidence on record, we have no doubt regarding the complicity of Paramjit Singh and Gurdev Singh. Paramjit Singh, according to the testimony of the eye-witnesses, was armed with a rifle and Gurdev Singh with a gun. Paramjit Singh in his statement before the committing magistrate admitted that he had a rifle, but, according to him, he had already sold that away. Gurdev Singh undoubtedly owned licensed gun P-1. According to the evidence of Dr. Ajit Singh who performed post-mortem examination on the body of Sukhdev Singh, Sukhdev Singh had a number of bullet injuries. Sukhdev Singh had also number of injuries caused by gunshots. The evidence of the eye-witnesses with regard to the part played by Paramjit Singh and Gurudev Singh is thus in conformity with the medical evidence. Although Paramjit Singh played the leading part in the assault on the two deceased persons, his rifle could not be recovered as he absconded after the occurrence and remained absconding for a period of more than eight months till his arrest on April 11, 1972. Gurdev Singh surrendered himself in the court of judicial magistrate Sunam on August 17, 1971. It is in the testimony of Shri J.K. Sinha, Assistant Director, Forensic Science Laboratory that three of the crime cartridges which were received in the laboratory on August 11, 1971 has been fired from licensed gun P-2 of Gurdev Singh. According to the evidence of Sub-Inspector Ajit Singh (P.W. 19) and Mann Dass (P.W. 4) gun P-2 was recovered in pursuance of the disclosure statement of Gurdev Singh subsequent to his surrender in court. There is no material to

1. *Charan Singh* v. *State of Punjab,* AIR 1975 SC 246: 1974 Cr LJ 1253.

warrant the inference that gun P-2 was secured by the police before Gurdev Singh surrendered in court on August 17, 1971. ASI Amrik Singh (P.W. 20) has deposed that he recovered a number of empty cartridges from the place of occurrence. Out of those empty cartridges, three were found by Shri Sinha to have been fired from gun P-2 of Gurdev Singh. There could, in our opinion, be hardly any doubt on the point that the three cartridges fired from the gun of Gurdev Singh were found at the spot because those empty cartridges were sent to the ballistics expert long before the arrest of Gurdev Singh and the recovery of his gun. It is significant that gun P-2 of Gurdev Singh is his licensed gun. No question of foisting a licensed gun upon Gurdev Singh could possibly arise in the very nature of things.

It was also not possible to falsely show the recovery of three empty cartridges which had been fired from that gun because at the time those three empty cartridges were sent to the Forensic Science Laboratory, the police was not in possession of gun P-2 of Gurdev Singh. The despatch of the three empty cartridges which had been fired from the licensed gun P-2 of Gurdev Singh lends assurance to the evidence about recovery of those cartridges from the place of occurrence.

The fact that three of the cartridges fired from the gun of Gurdev Singh were found at the place of occurrence goes a long way to corroborate the testimony of the three eye-witnesses regarding the complicity of Gurdev Singh.

1.9 Absence of Proof of Motive[1]

9. Be that as it may, the failure of the prosecution to establish the motive for the crime does not mean that the entire prosecution case has to be thrown over-board. It only casts a duty on the court to scrutinize the other evidence, particularly of the eye-witnesses, with greater care. The High Court was fully conscious of the need for such caution, and rightly observed:—

> *"The absence of proof of motive has this effect only that the other evidence bearing on the guilt of the accused has to be very carefully examined."*

Indeed, the High Court did so. The conviction of the appellant mainly rests on the evidence of Bhagwan Kaur P.W. 2, which had been corroborated in material particulars by independent evidence, including that of the ballistic expert, Mr. J.K. Sinha.

* * * * *

12. Then, there was the testimony of Mr. J.K. Sinha, ballistic expert who after examination of the empties (which were found at the scene of murder on the 18th December) and the licensed gun of the appellant, opined that those empties had been fired through the barrel of this gun.

13. Mr. Singh, however, contends that no empty cartridges had, infact, been found at the spot, and that this circumstantial evidence had been fabricated after the arrest of the appellant and seizure of the gun which took place on the 19th December.

* * * * *

1. *Nachhittar Singh* v. *State of Punjab,* 1975 Cr LJ 66 (SC).

15. The courts below have for cogent reasons rejected the defence contention and accepted the prosecution version that the appellant was taken into custody alongwith his gun, on the 24th December. We find no fault with that reasoning. The gun having been seized by the police on the 24th, there was no scope for fabrication, nor any ground for doubting the genuineness of the empties picked up from the scene on the 18th December, and which on the 24th December were no longer in the possession or control of the investigating officer. They were as deposed to by Shri J.K. Sinha, P.W. 12, in the possession of the Forensic Laboratory since the 21st December.

16. The testimony of Shri J.K. Sinha had not been seriously challenged in cross-examination. In his opinion the crime cartridges had been fired from the gun of the appellant. Thus the ballistic evidence confirmed the connection of the appellant with the crime.

1.10 Doubtful Recovery, Broken Chain of Custody, Inordinate delay[1]

Mr. Singh had sent the plain and blood stained earth, one Pajama, one Kurta, one Banyan, one underwear and one bullet, which was recovered from the dead body at the time of postmortem for chemical examination. He had also sent the 'katta' that was recovered at the instance of accused Imamuddin for examination by ballistic expert.

Before proceeding further, it is proper to mention the ante-mortem injuries found on the dead body of Nabi Sarvar.

1. "Fire arm wound of entry 4.00 cm x 1.00 cm x cranial cavity deep on right side frontal temporal region elliptical in shape, inverted margin, edges-blackened.
2. Fire arm wound of exit 2.00 cm x 1.5 cm x cranial cavity deep through and through on left side skull, 7 cm, above and lateral to left ear. Margin-everted, communicating to injury No. 1.
3. Fire arm wound of entry 1.00 cm x 1.00 cm x chest cavity deep on left side upper part of chest 7.00 cm, above left nipple at 2 o'clock position. Margin-inverted edge-blackened. Direction downward laterally. On internal examination:

Right frontal and temporal bones were found fractured, left parietal bone was also fractured, left and right lungs were punctured, one metallic bullet was found in the thoracic cavity.

In the opinion of the doctor, death was caused due to shock and hemorrhage because of ante-mortem injuries. Death had taken place within one day.

The learned counsel for the appellant argued that the trial court has committed illegality in finding the appellant guilty for the murder of Nabi Sarvar. When the evidence of PW 1 Zahir Ahmad and PW 2 Rais was disbelieved in respect of accused Nasruddin, it ought not to have been accepted in respect of Imamuddin. He further argued that the learned trial court has laid emphasis upon the fact that a country made pistol was recovered at the instance of Imamuddin and as

1. *Imamuddin* v. *State of Uttar Pradesh,* 2009 Cr LJ 4477.

per the ballistic expert report, the same was found to have been used in the commission of the crime. He argued that the prosecution has failed to prove that the alleged recovery of firearm was pursuant to any disclosure statement of Imamuddin and that the recovery itself was doubtful, as the independent witnesses of recovery namely, Mushtak Ahmad and Akik Ahmad, were not examined in the court. Moreover, the alleged recovery was made from an open place, which was accessible to each and everyone. He further argued that the bullet, which was recovered from the dead body at the time of post mortem, was sent to the Superintendent of Police, Azamgarh in a sealed cover and the prosecution has failed to lead any link evidence that it was the same bullet, which was sent for examination by ballistic expert.

Moreover, this fact can also not be left off the sight that the alleged recovery of the pistol was made on 5-6-1998 whereas the incident had taken place on 13-11-1997. Thus the recovery of the pistol has been made say about six months after the occurrence. In this connection a judgment of Hon'ble the Supreme Court in *Gopal Sah* v. *State of Bihar,* 2009 (64) ACC 997 may be referred. In that case, the accused were arrested and on their disclosure statements, blood stained axe and a sickle allegedly used in the murder.

As the recovery of the pistol is highly suspicious and cannot be placed reliance the knowledge of the accused Imamuddin as to its concealment beneath the earth also cannot be believed.

Learned counsel for the appellant argued that no reliance can be placed upon the report of ballistic expert (Ext Ka 6) to the effect that the bullet (recovered from the dead body of Nabi Sarvar) was fired from the pistol allegedly recovered at the instance of appellant as it is highly doubtful that the bullet remained intact and was not tampered with till its examination by ballistic expert. It is to be noted that as per the post mortem report Ext Ka 2, the metallic bullet found in the dead body of Nabi Sarvar was kept in sealed envelope and was given to the constable who had accompanied the dead body.

The prosecution has not led any evidence that after the bullet was received from the doctor where it was kept. If it was kept at the Malkhana of the police station concerned, then no police official of the Malkhana has been examined to prove that nobody was allowed to tamper with the bullet and it remained in the sealed cover till the same was sent to the scientific laboratory for examination. If the bullet was sent from the Malkhana of the Police Station to the Sadar Malkhana then no one from the Sadar Malkhana has been examined to depose as above.

However, from the report of the scientific laboratory (Ex Ka 4) it appears that the bullet along with other materials (such as plain and blood stained earth and the clothes of the deceased) was received in the scientific laboratory on 20-8-1998 through special messenger. The post mortem was done on 14-11-1997. It is thus clear that the bullet remained at the police station for about nine months and there is no reason as to why the bullet was not sent to the laboratory at an early date.

The pistol was allegedly recovered at the instance of the accused on 5-6-1998. There is no evidence on record to show as to where the pistol was kept after its recovery *i.e.* either at the police station Malkhana or in the Sadar Malkhana. Again, no link evidence has been produced to prove as to when this pistol was sent for ballistic expert examination. The ballistic expert report is (Ext Ka 6) on the record which shows (that the pistol was received for ballistic expert examination on 24-12-1998 from the sero-section of the scientific laboratory Lucknow. However, there is no evidence as to when the pistol was sent from the police station or the Sadar Malkhana to the scientific laboratory. In any case, the pistol after its alleged recovery on 5-6-1998 reached the ballistic expert only on 24-12-1998 and no reason for this delay has been given. It is therefore, apparent that the police had in its possession not only the bullet recovered from the dead body but also the pistol that was allegedly recovered at the instance of accused Imamuddin and there was many opportunities with the Investigating Officer to tamper with the bullet during this period.

The inordinate delay in sending the bullet and pistol for scientific and ballistic expert elimination creates strong suspicion whether the alleged recovered bullet was sent to the ballistic expert or in its place another bullet fired from the recovered pistol was sent to the ballistic expert for comparison as there was ample opportunity for the police to have done so. In these circumstances, the report of the ballistic expert also loses its importance.

1.11 Improvised Firearms as Evidence[1]

9. It was strenuously urged by Mr. Kohli for the appellants that if the expert, in all probability, could have examined the bullets he could have found that both were fired from the same firearm because of the specialty of the rifling grooves left on the bullets when they were fired. Counsel submitted that the expert's opinion would have demolished the prosecution case that the two brothers had fired two shots—one at Amar Singh and the other at Balbir Singh—from two different pistols. It is unfortunate that the opinion of the expert could not be obtained in this case. However, that does not shake the prosecution case in the least. The pistol said to have been produced by appellant Dayanand must not necessarily be the one, which he used in the occurrence. Unless there were rifling marks on the bullets and which were not defaced by the entry in the bodies of the victims, no expert could ordinarily and generally give an opinion. J.S. Hatcher in his Text Book of Fire Arms Investigation, (1946 Print) at page 255 has referred to the rifling marks on bullet and has said that "such identifying marks are "caused by its passage over surface irregularities and rough spots on the interior of the gun barrel that got there principally during the machining operations of reaming the bore and rifling the grooves". However, the learned author has pointed out at page 256:

> *"It should be understood by the reader that some guns have the barrels smoothed up after machining by a process known as lapping. A rod is inserted into the barrel, and a lead plug is cast on the end of this rod, so that it exactly fits the lands and grooves. This lead plug is then covered with oil and emery flour,*

1. *Chatar Singh* v. *State of Haryana*, 1976 Cr LJ 1891: AIR 1976 SC 2476.

and passed back and forth through the barrel a number of times, until the most noticeable roughnesses are removed. This operation makes the inside of the barrel much smoother than it would otherwise be, and adds somewhat to the difficulty of bullet identification".

None of the appellants had a licensed pistol. In all probabilities, therefore, they had used country-made pistols. In such a situation, it is difficult to assume that the Ballistics Expert could have found identifying marks on the bullets[1] and his opinion would have gone against the prosecution. We do not think that the prosecution had any design or motive in not obtaining the opinion of the Expert.

1.12 Butt-end as Evidence[2]

In fact, both the courts have arrived at the conclusion that the statements of the eyewitnesses have been corroborated by the medical evidence. Then there is the further fact that when appellant Nirpat Singh was arrested on November 12, 1970, gun Ex. 3 was recovered from his house and it was found that a part of its wooden butt-end was missing. It will be recalled that the broken piece Ex. 2 of the butt-end had been recovered from the place of the second incident the same day, before the seizure of the gun, so that there can be no doubt that it fell down at the place of the incident.

The ballistics expert has stated that the broken piece Ex. 2 belonged to the recovered gun Exhibit 3. The evidence, which has been led in this connection, lends further assurance to the correctness of the evidence of the eyewitnesses.

Then there is the further fact that while fired cartridge Ex. 15 was recovered from the site of the first incident early in the morning of November 12, 1970, fired cartridge Ex. 33 was recovered from the site of the second incident. It has been proved by the ballistics expert that these cartridges had been fired from appellant Nirpat Singh's gun Ex. 3. Cartridge Ex. 16 was also recovered from the site of the first incident, but it was found that it had not been fired from Nirpat Singh's gun. This shows that another gun was also used in the incident.

1.13 Projectile Location – X-Rays[3]

We cannot part with this case without making reference to certain defect in the investigation and in the conduct of the doctor (P.W. 64) who held the post-mortem examination on the dead body of Prawakar.

According to the post-mortem report, there were gunshot wounds. The entrance wound was noticeable but not the exit wound. It was the duty of the

1. The bore surface of the country-made (improvised) firearms is quite rough. Usually, It imprints striation marks on the passing projectile in greater number than those by a standard rifled firearm. The only basic requirement is that the projectile should fit in the barrel and come in close content with the barrel surface during its passage through the barrel. The identifying marks have been recognised and accepted by the Supreme Court in the case: *State of Madhya Pradesh* v. *Paltan Mallah*, 2005 Cr LJ 918 (SC). The above statement of the court in this regard in therefore, is not valid. Had the IO sent to the Forensic Science Laboratory, the Ballistics Expert could have found whether the two bullets had been fired from one or two firearms. **(Author's Note).**
2. *State of Punjab* v. *Pritam Singh,* 1977 Cr LJ 1575 (SC).
3. *State of Orissa* v. *Ram Chandra Bhoi,* 1965 (2) Cr LJ 525: AIR 1965 Ori 175.

medical officer (P.W. 64) to have directed X-ray examination of the dead body to determine if bullets were located in the body. It was the duty of the I.O. to see if bullets were inside the dead body and if those bullets, if recovered, were proved by ballistic examination to have been shot from the revolver (M.O. XXXVI) which admittedly belonged to Srinivas and from whose possession it was recovered. We cannot disabuse our mind of the impression that this omission cannot but be deliberate. The matter was so patent that no investigating officer would ignore it.

1.14 Non-location/recovery of the projectiles[1]

The medical evidence disclosed that Shiv Singh, the deceased, had three gunshot wounds in his body, all in front, two on the chest and one in the stomach. All the three wounds were on the left side of the front of the body. The doctor said that any one of the three injuries would have proved fatal in itself and that all the three wounds could be caused by a single discharge from a gun.

Unfortunately, none of the shots or the bullets has been recovered. If they had been recovered, it would have been easy to determine whether they were fired from one gun or two. One of the guns alleged to have been used was a breech-loading double barrel gun with hammer action. The other was an old-fashioned muzzle-loader. Presumably, the type of shot used in the more modern weapon would have been different from the crude pellets or slugs one would expect in a muzzle-loader. Appellant B had admitted his guilt from the start and taken all the blame on himself. Appellant A, on the other hand, has denied throughout that he has taken any part in the shooting though he admitted he was present at the scene with a gun in his hand too. The fact on which everyone is agreed is that two shots were fired. However, the question is whether B fired both as he said or whether he fired one and A fired the other. The medical evidence does not disprove the defence version. The doctor said one shot could have caused all the three wounds. If one, then of course two could equally have caused three wounds and one person could have fired those two shots. The post-mortem examination does not prove the contrary. The unfortunate omission to recover the shots or slugs in the body has deprived the court of evidence, which might have been of great value on this point. The defence version was that B had the double barrel gun and that he fired two shots from it. A did not use his gun which according to the defence, was the old-fashioned single barrel muzzle-loader. Therefore, in the absence of any reloading the double barrel gun would have both barrels without live rounds and would be found in an unloaded condition. The muzzle-loader, unless it was already empty, would still be loaded. Now, it has been accepted throughout that, the muzzle-loader was found loaded when it was seized. The question was about the double barrel gun. One of the witnesses to the seizure admitted that only one gun was found loaded though he could not remember which. There was no reason why his admission should be brushed aside. It accords with the defence version in a very material and important particular. The appeal of A was allowed.

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1. *Hate Singh* v. *State of Madhya Bharat*, 1953 Cr LJ 1933 (SC): AIR 1953 SC 468.

1.15 Missed Cartridge as Evidence[1]

6. The cartridges were sent to the Forensic Science Laboratory. There is the evidence of Mr. J.K. Sinha and his report is marked Exhibit P-21. He said that two sealed parcels were received in the laboratory on 12 May, 1969. One of the sealed parcels contained one .303 bore rifle marked 'A' by him. That is the rifle received from the appellant. The second sealed parcel contained two .303 fired crime cartridge cases and one .303 missed cartridge. His evidence was that the two fired crime cartridges had been fired through the .303 rifle. His opinion about the missed cartridges was that the firing pin impression on the missed cartridge tallied with the firing pin impression on the .303 rifle marked 'A'. He examined the two fired test cartridges. He also examined the test cartridges under a comparison microscope for individual characteristic markings present on them. He compared the same with individual characteristic markings present on the fired or crime cartridges. On comparison, he found that the firing pin marks present on the test cartridges tallied with the firing pin marks present on the crime cartridges in their individual characteristics. Mr. Sinha said that the fired cartridges were fired through the rifle marked 'A' and could not have been fired from any other rifle even of the same make and bore because every firing pin has its own individuality. He took photomicrograph, which showed some of the similar individual characteristics.

7. The rifle was under a sealed cover. It was opened in this court. The magazine chamber was found to have the same number as in the report Exhibit P-10. The submission on behalf of the appellant that there was difference between the number of the rifle in the magazine chamber and in the report was, therefore, not acceptable.

8. The entire evidence was rightly believed by the High Court. The High Court then correctly confirmed the capital sentence. The appeal fails and is dismissed.

1.16 Wads as Evidence[2]

7. We have a vague indication that these two jointly, or one of them, might have had something to do with the killing of Khandiya because the corpse was found just outside their house and the killing was with a muzzle-loading gun and Chema has a muzzle-loading gun and further, though these points are not so definite, the wadding found in one of the gunshot wounds in the corpse was similar to the wadding found in Chema's house. The gun itself had signs of having been used sometime before the examination. The problem then is whether this is sufficient, and if so, whether they were acting with a common intention, or, which comes to the same thing, each abetting the other, and if each was acting independently which of the two it was. In the absence of common intention the evidence has to be led pointing to one out of the two because the shooting of the gun was a one-man job whoever it was.

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1. *Mukhtikar Singh* v. *State of Punjab,* 1971 Cr LJ 1298 (SC): AIR 1971 SC 1864.
2. *Chema Mahariya* v. *State of Madhya Pradesh*, 1969 Cr LJ 1291 (MP).

12. The result is that apart from the statements attributed to either of the accused persons there is really no evidence against either jointly or individually. Something like a circumstance is found in the fact that a muzzle-loading gun had been used; but even that is not very illuminative because it has not been brought out that Chema is the only owner of a muzzle-loading gun in that village. Wadding of the type found in one of the wounds and in Chema's house is of a common variety; but assuming that Chema Bhilal's gun had been used and then put on the dung heap, that by itself while creating suspicion may not point to one or the other definitely as the offender. One of the two might have used it. Each of them had at different stages been anxious to take the blame on himself or herself and spare the other and each indicated that they were justified in shooting Khandiya. If there was any other evidence we could pin the responsibility on one of the two definitely or even make out common intention; but we have nothing. Thus, it would be a case of no common intention and uncertainty to which of the two had shot. Further, if one takes into account the recorded statement of the woman, then again it would be a case of justification in self-defence as the person killed was trying to abduct her with the intention of compelling her to sexual intercourse. If we reject that statement, nothing is left. The only conclusion a court can arrive at is that it is a fit case for the benefit of doubt to both the appellants.

1.17 Pellets Link[1]

Criminal Appeal Nos. 98-102 of 1999 and Criminal Appeal Nos. 109-114 of 1999 are filed by the State of Madhya Pradesh through CBI and the Criminal Appeal Nos. 103-108 of 1999 are filed by the Chhattisgarh Mukti Morcha. All these appeals arise out of the common Judgment passed by the High Court of Madhya Pradesh on 26-6-1998. Nine accused persons were tried by the Second Addl. Sessions Judge, Durg, M.P. Accused Nos. 1 to 8 were charged for the offence under section 302 read with section 120B, IPC. The 9th accused was charged under section 302 read with section 120B, and in the alternative, section 302 read with section 34, IPC and section 25(1)(A) and section 27 of the Arms Act. The Sessions Judge acquitted A-6 Naveen Shah, A-7 Chandrabaksh Singh and A-8 Baldev Singh Sandhu. A-1 Chandrakant Shah, A-2 Gyan Prakash Mishra, A-3 Avdhesh Rai, A-4 Abhay Kumar Singh, A-5 Moolchand Shah and A-9 Paltan Mallah @ Ravi were convicted by the Sessions Judge for the offence under section 302 read with section 120B. A-9 Paltan Mallah was found guilty of the offence punishable under section 302, IPC and sentenced to capital punishment whereas other accused were sentenced to life imprisonment. The High Court by the impugned Judgment acquitted all the accused of the charges framed against them.

Deceased Shankar Guha Yogi was a popular, powerful trade union leader in the industrial region of Bhillai, Durg, which was part of the then State of Madhya Pradesh. Deceased Shankar Guha Niyogi had been working for the welfare of the labour demanding living wages, bonus, reinstatement of retrenched workers and he organised the workers of the various industrial units at Bhillai and Durg. The

1. *State of Madhya Pradesh* v. *Paltan Mallah,* 2005 Cr LJ 918 (SC).

labourers had an organisation by name "CHHATTISGARH MUKTI MORCHA" (hereinafter being referred to as CMM") and deceased Niyogi became a leader of this organisation. He was leading the labourers working at Rajaram Mines area which was a main source of raw material iron ore for the Bhillai Steel Plant at Durg. In the year 1989, there was an agitation by the workers of industrial unit by name ACC, which is a leading cement manufacturer. A settlement was reached at the instance of deceased Niyogi. The workers in other industrial establishments sought the help of deceased Niyogi to solve their problems. In the year 1990, he came to Bhillai and started occupying quarter No. MIG 1/55 of HUDCO. He stayed there with his servant Bahal Ram. The other members of his family continued to stay near Rajhara. Deceased Niyogi set up an office for CMM at MIG-2/273 HUDCO. In the year 1990, there was widespread labour movement against the management of various industrial units such as Simplex, Kedia, B.E.C. B.K, etc. According to the prosecution, the management of these industrial units started opposing the labour movement and there was even physical attack on some of the leaders of CMM. One Uma Shankar Rai, a leader of CMM was fatally assaulted by the agents of the industrialists. Deceased Niyogi apprehended serious threat to his life from the industrialists, especially from Simplex and Kedia Group of Industries. He made notes in his diary regarding the apprehension of danger from the management of these industrial units. On 27-9-1991, he had gone to Raipur and there he met one Rajendra Sail, Secretary General of PUCL and reporter N.K. Singh of "India Today". He expressed an apprehension of danger to his life from Kedia and also from A-5 Moolchand Shah and A-1 Chandrakant Shah of Simplex Group. On 27-9-1991 at about midnight, he left Raipur for Bhillai and reached his quarter No. MIG-1/55 of HUDCO and went to bed. His servant Bahal Ram was occupying the neighbouring room. In the night, Bahal Ram heard a noise like bursting of crackers and he rushed to the room of Niyogi and found Niyogi writhing in pain on is bed. The window was found open. Bahal Ram called for help of the neighbour Sripad Mategaonkar. Few workers from the CMM came to the place and it was found that Niyogi had been shot. He was immediately taken to the Sector 9 Hospital of Bhillai. Before reaching the hospital, Niyogi succumbed to the gun shot injuries. Post-mortem examination was conducted by a team of doctors and they opined that death was due to bullet injuries.

Preliminary investigation was carried out by PW-182 Deputy Superintendent of Police Shri M.G. Agarwal. There was agitation by the workers that investigation shall be conducted by the Central Bureau of Investigation and the Government of Madhya Pradesh requested the Union of India seeking help of the Central Bureau of Investigation. As part of police investigation, PW-182 visited the scene of occurrence and got prepared map of the site and he took steps to see that viscera of the victim was sent for laboratory tests. He took into custody the pellets recovered from the body of Niyogi. He took statements from Bahal Ram, the servant and also from the widow and daughter of deceased. He got prepared photograph Exh. P-180 to P-196. He got report from Serum Science and Chemical Analysis which are marked as Exh. P-430 to P-432. He recorded statements of various other witnesses. Accused A-3 Avdhesh Rai was taken into custody on

13-10-1991. On 1-11-1991, he seized diary of deceased Niyogi and on 9-11-1991 he handed over the investigation to CBI officials.

PW-187 R.S. Dhankad took over the investigation along with PW 192 R.S. Prasad. PW-187 held search of Oswal Industry. He recorded the statements of Zakkiruddin on 21-11-1991. This witness identified the photographs of A-2 Gyan Prakash Mishra and A-3 Abhay Kumar Singh. PW-192 conducted further investigation of the case along with other officers. On 10-11-1991, he seized the window curtains from the house of Niyogi. On 15-11-1991, he conducted searches of the business premises of Jain and Shah and Company, 108 A. Khan Goga Complex and recovered articles under Exh. P-297.

After the arrest of accused Paltan Mallah on 25-8-1993, he got recovered 12 bore country made weapon, 13 live cartridges of 12 bore, a foreign made revolver, 6 live cartridges of .38 bore and a red colour Suzuki motorcycle. He sent Exh. P-403 and 404 to Central Forensic Laboratory (CBI), New Delhi. He conducted various other searches and recovered incriminating articles from the other accused. After investigation, final report was filed.

On the side of prosecution PW 1 to PW-192 were examined by the trial court.

The High Court by the impugned judgment acquitted all the accused and that is challenged before us.

The next evidence against the ninth accused came to surface in 1993 at the time of his arrest by an air-force officer alleging that he was in illegal possession of certain firearms. The air-force officer handed over the ninth accused to PW-125, who was a sub-inspector at the Rudrapur police station. On questioning Paltan Mallah, PW-125 came to know that he had been involved in the murder of Shankar Guha Niyogi. He informed the CBI officials and recorded the confession made by Paltan Mallah. Based on the confession given by accused Paltan Mallah, certain recoveries were effected.

Based on the information furnished by him, PW-125 along with PW-104 Dinesh Baloni left for the village Nibahi and reached the place which according to the prosecution was the house of the accused Paltan Mallah. Another witness Farukh Mirza Baig accompanied them. This witness is a resident of Nibahi. The accused pointed out that near the northern wall of the house he had buried certain articles. The accused Paltan Mallah removed the earth, took out a bundle wrapped in a plastic sheet. The bundle contained a country-made pistol with 13 cartridges, 2 L.G. cartridges and others were .38 bore cartridges. PW-125 recovered these articles and in the seizure memo, Dinesh Baloni, one Ram Bahadur and Farukh Mirza Baig and the accused had signed. From there, they left and reached the house of PW-105, Satyaprakash Nishad, in village Chainpur, where the accused had hidden his TVS Suzuki motorcycle. The motorcycle was recovered and there was no number plate on the motorcycle.

The recovery of the country-made pistol at the instance of the accused Paltan Mallah was seriously challenged on various grounds. It was contended by the counsel that the recovery of the weapon was not effected in accordance with law and the witness PW-104 Dinesh Baloni was not a resident of the village

Nibahi and that he was brought from a different place only for the purpose. It was argued that as recovery was not effected in accordance with law, the entire evidence is inadmissible as the search itself is illegal. The counsel further contended that the recovery of weapons at the instance of the accused Paltan Mallah is not admissible in evidence as the disclosure statement marked Exh. P-285 would only show that the accused had the knowledge of the concealment of the weapon and that he was not the author of that concealment. Counsel for the accused Paltan Mallah placed reliance on two decisions, namely, (1976) 1 SCC 828: (1976) 1 SCR 715: (1976) 1 SCJ 517: 1976 Cr LJ 481: AIR 1976 SC 483, *Mohmed Inayatullah* v. *State of Maharashtra* and (1980) 1 SCC 530: (1979) CAR 340: 1979 Cr LJ 1310: AIR 1979 SC 1949, *Pohalya Motya Valsi* v. *State of Maharashtra*. The above two decisions are not relevant in this case as in the Exp. P-285 the accused specifically says that he concealed the weapon himself. As the alleged confession clearly states that the accused himself has concealed it, the recovery of the weapon assumes importance in this case.

The counsel for the respondent-accused further contended that PW-125 was not investigating the case of accused Paltan Mallah and that the custody of the accused Paltan Mallah was entrusted to him alleging that he had unlawfully trespassed into the prohibited area belonging to Air-Force and PW-125 could have conducted investigation of that case only and if at all he had come to know of the involvement of the accused in other cases, he should have contacted the CBI and informed them of the alleged concealment of weapon. It was pointed out that the CBI officers had reached that place and met PW-125 even before he went with the accused Paltan Mallah for the alleged search and seizure. The counsel submitted that the search and seizure was completely illegal and therefore the evidence obtained under such illegal search is to be completely excluded. The plea of the appellant cannot be accepted.

Then the most important item of evidence against the accused, Paltan Mallah, is the report of the ballistic expert. PW-192, the Deputy Superintendent of Police of the CBI deposed that after the arrest of the appellant Paltan Mallah on 25-8-1993, he recovered one 12 bore country-made pistol, 13 live cartridges 12 bore, one foreign made pistol, 6 live cartridges of .38 bore and a motorcycle. The country-made pistol, the foreign made pistol and the cartridges were sent for examination by the ballistic expert to the Central Forensic & Science Laboratory, New Delhi. During the post-mortem of the deceased Shankar Guha Niyogi, three pellets were extricated from his body. These pellets were sent to Forensic Laboratory at Sagar and thereafter they were deposited in the court by PW-192 and these pellets were also later on obtained from the court and sent for examination by the CFSL. PW-159, the ballistic expert conducted detailed laboratory test-fires and microscopic examination and he gave Exh. P-398 report wherein he opined that three lead pellets marked P-1 to P-3 must have been fired from a 12 bore country-made pistol. He deposed that he had prepared the report on the basis of the microscopic examination and he had also taken photographs of the pellets and Exh. P-398 are the work-sheets of the report prepared by him.

The evidence of PW-159 and his report are seriously challenged by the counsel for the respondent accused. He extensively referred to the text books written by foreign ballistic experts such as Burrad, Hatcher and Taylor. It was argued that in the instant case, the weapon was a country-made pistol and the barrel was not grooved and there was absolutely no question of any identifiable marking coming on the pellets to enable the expert to give any opinion whatsoever. Reliance was placed by him on the observations of this Court in Ram Avtar v. Ram Dhavi, (1997) 2 SCC 263: 1996 AIR SCW 4264: AIR 1997 SC 107: 1996 All LJ 1908 wherein this Court relied on the opinion of J.S. Hatcher in his text book of Fire Arms & Investigation to the effect that "unless there were rifling marks in the bullets which were not defaced by the entry in the bodies of the victims, no expert can ordinarily and generally give an opinion." It was also pointed out that in the case of country-made pistol, it was difficult to assume that the ballistic expert could have found identifying marks on the pellets. The evidence given by the ballistic expert was questioned in great detail. He was cross-examined extensively by counsel for all the accused. He deposed in the cross-examination that when these pellets are fired, then they among themselves would press each other inside the barrel [on inside parts] their effect could be on one side of inner side of barrel, they will take special individual mark on them and these marks will be in the form of a line on the pellets and if the barrel is tight then pellets will be more rubbed, and on more parts, lines will come. If barrel is tight then half part of the pellets are pressed and the barrel was nicely tight and the witness himself said that in the test fire which he did on all of the six pellets good marks of barrel had come. He had also stated that he had taken micro-photograph of only one pellet and had compared all pellets but he had not made any separate comparative record or photograph.

It was argued that micro-photographs were not produced and mere observation by the expert—was not sufficient and that he should have produced these photographs. We do not think that there was any such necessity to produce the micro photographs when the expert has given convincing reasons to support his opinion. This Court in *Ramanathan* v. *State of Tamil Nadu,* (1978) 3 SCC 86: 1978 Cr LJ 1137: AIR 1978 SC 1204 para 26 held that the production of such photographs is not necessary and such a plea was rejected. In paragraph 26, it was held as under:

> *"It is true that there has been considerable difference of opinion amongst investigators regarding the use of photographs in a court for the purpose of illustrating the matching of the markings, and while it may be that microscopic photographs, when taken with due care and in the best of conditions, may enable the evidence to be placed on the record in a visible form, it cannot be denied that a court would not be justified in rejecting the opinion of an expert who has examined the markings under the comparison microscope simply for the reason that he has not thought it necessary to take the photographs. It is therefore not possible for us to reject the evidence of Ramiah (PW 23) who has categorically stated that he had compared the land and groove markings on the bullets under a comparison microscope, simply because he did not think it necessary to take the photographs."*

In the case of the respondent-accused Paltan Mallah, there is overwhelming evidence to prove his complicity in the crime. The recovery of the country-made pistol at his instance, which is proved to have been used for causing the death of Shankar Guha Niyogi; and the evidence of the ballistic expert coupled with two extra-judicial confessions made to PW-105 made PW-124 support the prosecution case fully. There is also prosecution evidence to the effect that the accused had got accessibility to the weapons and that he was staying at the place of occurrence and doing various jobs. It is also established that accused Paltan Mallah is involved in other offences relating to fire-arms. Though there is no direct and convincing evidence against other accused, the case against Paltan Mallah is proved beyond reasonable doubt. He was acquitted by the High Court on fanciful reasons. The evidence of extra-judicial confessions was rejected without any valid reasons. The report of the ballistic expert also was not appreciated in the correct perspective by the High Court. In our view, the Division Bench seriously erred in acquitting the respondent-accused Paltan Mallah.

In the result, we reverse the acquittal of the respondent-accused Paltan Mallah. The incident leading to these appeals had taken place as early as 1991. As there is a long lapse of time, we do not think that the sentence of death imposed upon him by the Sessions Court is justified in the circumstances. We set aside the acquittal of respondent-accused Paltan Mallah and find him guilty of the offence punishable under section 302, IPC and sentence him to undergo imprisonment for life.

1.18 Air Gun as Evidence[1]

Mr. A.T.M. Sampath, learned senior counsel appearing on behalf of the appellant, urged that the prosecution cannot be said to have proved the guilt of the appellant who was convicted only on the basis of purported circumstantial evidences. The learned counsel contended that the circumstances against the appellant were not such which could be said to have completed all links in the chain inasmuch as the ownership of the air gun was not proved. The pellets which were noticed by the autopsy surgeon in the dead body of Senthil had not been removed nor the recovery of the air gun can be said to have been made in accordance with law. It was further submitted that the purported extra-judicial confession which was recorded by a person not authorized therefor in view of rule 72 of Criminal Rules of Practice (CRP) in terms whereof a village magistrate is prohibited from recording the extra-judicial confession or statement whatever made by an accused person after the police investigation has begun.

Mr. Subramonium Prasad, learned counsel appearing on behalf of the respondent, however, supported the judgment contending that the circumstantial evidences against the appellant had been fully proved in view of the fact that:

(i) he was last seen with the deceased;

(ii) his conduct in leaving the place of occurrence and going to the State of Kerala for a few days;

1. *Sivakumar* v. *State of Tamil Nadu*, 2006 Cr LJ 536 (SC).

(iii) extra-judicial confession; and

(iv) recovery of air gun at his instance from Pappannan Thottam canal.

The High Court in its judgment relied upon the following circumstances:

"(i) Evidence of P.W. 1 that he saw Senthil along with the appellant/accused-Sivakumar, P.W.-7 Ravikumar on 17-9-1995, 11.00 a.m. and that Senthil was last seen alive in the company of the appellant/accused.

(ii) The appellant/accused purchased M.O.I. Air Gun from the shop of P.W.8. -Prakash; M.O.I. - Air Gun is in working condition and the death was due to Gun Shot wound and the opinion evidence of P.W.11 - 17. P. Rajan (PW-9) is the forensic expert. In his evidence, he stated:

"……The above gun was with .22 inches or 5.5 m.m. pipe dia and operated by air. I found the gun was in shooting condition while I shot it for test. The speed of the pellet shot from this gun is 400 feet per second. The pellets had not penetrate (sic) one inch thick deal wood plank at the range of 5 feets as per the tests done under the rules specified under Arms Act, 1962. So licence is not necessary to possess such a gun. The office copy of letter received from Judicial Magistrate No. 2 Polachi by Forensic Science Department, Chennai is Exhibit P-7. The test report submitted by me is Exhibit P-8. There is chance to cause death if the human body is shot from very nearer……..."

Contention of Mr. Sampath is that the air gun was received in two parts, namely, wooden part and iron part separately and, thus, the evidence of PW-9 should not be relied upon. We do not see any reason to accept the said contention because for the purpose of carrying out tests in the forensic laboratory, the iron part of the gun was material.

PW-10 was the head constable. His evidence is not material. Dr. Jothi Arunachalam (PW-11) conducted the post-mortem examination on the body of the deceased. As noticed hereinbefore, Mr. Sampath submitted that the pellets had not been recovered. PW-11 categorically stated that the foreign body seen through X-ray could not be recovered despite great effort made in this regard during post-mortem. He noticed that the penetrating injury was in the vital organ of the chest part.

In view of the aforementioned statement of PW-11, we are of the opinion that non-recovery of the pellets from the body of the deceased during post-mortem examination was not very material so as to discredit the entire prosecution case.

PW-12 is a formal witness who proved some documents. PW-13 is a retired head constable who registered the case. PW-14 is the Inspector of Police Station before whom the appellant was produced by the Village Administrative Officer. He recovered the air gun produced by the appellant which had been kept under the Pappanan Thottam canal at about 6.30 a.m. on 30th September, 1995.

The ownership of the air gun was not necessary to be proved. Recovery of the said air gun was made at the instance of the accused in terms of section

27 of the Indian Penal Code. When the possession of the air gun and recovery thereof had been proved, in our opinion, ownership takes a back seat.

1.19 Number of Shots[1]

As we did not find ourselves in agreement with the above opinion in some of its aspects, especially that covering the type of projectile which caused injury No. 5, we had the entire matter examined by Dr. B.R. Sharma, Director, Forensic Science Laboratory, Chandigarh, to whom gun Exhibit P. 3 and the projectiles recovered from the dead body were made over for observation and opinion, he being a ballistic expert who was examined as C.W. 1. He was of the view that injuries Nos. 1 to 4 could have been caused by a single shot fired from gun Exhibit P. 3 and that injury No. 5 could have resulted from another shot discharged from the same gun. He was subjected by Mr. Sibal to a lengthy and searching cross-examination during the course of which he made the following points:—

(1) Injuries Nos. 1 to 4 could have been caused thus. The shot was fired from a distance of about 3 to 8 feet. The left shoulder of the victim was nearest to the muzzle of the gun and his head and face were turned towards the left. Three of the pellets caused injury No. 4. Two of them and the wads caused injury No. 1 and a single pellet resulted in injuries Nos. 2 and 3.

(2) Injury No. 5 was caused by a shot from a distance of 2 to 5 feet, so that the charge entered *en masse*, although the whole of it was not recovered from a dead body. Tattooing and blackening should have been present in the case of this injury. The opinion of doctor (P.W. 2) that this injury was caused by a projectile having a diameter of about 1", is not correct.

(3) In the case of both the shots, the ammunition used could have consisted of L.G. cartridges.

(4) Charring is more often than not confused with the deposit of dirt around the wound or with contusions caused by the impact of the projectile. Tattooing would be observed in the case of a wound caused by a shot fired from a distance upto 8 feet.

(5) Injuries Nos. 1 to 4 could not have been caused by a shot fired from a distance of "within 2 feet". This opinion is based on the impossibility of injuries Nos. 2 and 3 having been caused by a separate shot.

(6) In the case of injury No. 4, the pellets skipped. If they had entered the body at the seat of the injury, the damage caused would have been extensive. On the left shoulder part of the shirt of the deceased were observed five holes, three of which indicated entrance of the pellets and two their exit, two of the former being in line with the latter and fifth one being very small in size with its location just above the other two entrance holes.

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1. *Om Prakash* v. *State of Haryana*, 1971 Cr LJ 1109 (SC): AIR 1971 SC 1388.

(7) The phial said to contain the small pellet recovered from one of the wounds comprised in injury No. 4 had inside it only pieces of dried blood and no pellet.

The science of ballistics on which the testimony of Dr. Sharma (C.W. 1) is mostly based attaches quite some importance to the factors determining the distance from which a firearm causing a particular injury was probably discharged and we think it only right to take not at this stage of standard treatises on the subject. Reference may be made with advantage to the following passages appearing at pages 236 and 237 of Modi's *Medical Jurisprudence and Toxicology* (1969 Edn.):

> *The effects produced by small shot fired from a shotgun vary according to the distance of the weapon from the body, and choking device. A charge of small shot, fired very close to, or within a few inches, of the body enters in one mass like a single bullet making a large irregular wound with scorched and contused edges, and is followed by the gases of the discharge which greatly lacerate and rupture the deeper tissues. Particles of unburnt powder expelled from the weapon behind the missile are driven to some distance, through the wound, and some of them are found embedded in the wound and the surrounding skin which is also singed and blackened by the flame and smoke of combustion. The exit wound of a close range shot shows greater damage of tissues than the entrance wound, the margins are everted, but there is no evidence of blackening or singeing. At a distance of one to three feet small shot makes a single aperture with irregular and lacerated edges corresponding in size to the bore of the muzzle of the gun, as the shots enter as one mass, but are scattered after entering the wound and cause great damage to the internal tissues. The skin surrounding the wounds is blackened, scorched and tattooed, with unconsumed grains of powder. On the other hand, at a distance of six feet the central aperture is surrounded by separate openings in an area of about two inches in diameter made by a few pellets of the shot which spread out before reaching the mark. The skin surrounding the aperture is not blackened or scorched, but is tattooed to some extent. At a distance of twelve feet the charge of shot spreads widely and enters the body as individual pellets producing separate openings in an area of five to eight inches in diameter, but without causing blackening, scorching or tattooing of the surrounding skin. At a distance of about 50 feet a pattern measuring about 14 inches from a fully choked barrel and about 28 inches from an unchoked barrel are produced and at about 100 feet the spread pattern on the target is about 30 inches from the fully choked barred and 50 inches from an unchoked one. The scattering of shot depends upon the size of the gun, the charge of the powder and the distance of the gun from the body. As the distance increases, the damage caused by a single pellet diminishes.*
>
> * * * * *

If over shot cardwad is found in the wound it indicates that the shot was fired from less than two yards while its absence suggests more than two yards.

In conclusion it must be noted that it is not easy to give a definite opinion about the distance from which a firearm was discharged. According to Taylor's *Principles and Practice of Medical Jurisprudence* (Ed. X, Vol. I,) p. 441, no general rule can be laid down.

This is what John Glaister says on the subject at pages 244 to 247 of his work of the same name (1962 Edition):—

> *These weapons have for their projectile, collections of small shot which vary in size, depending upon the type of cartridges employed. The small shot or lead pellets are held in position by wads, one placed between the powder and shot charges, the other on the top of the shot charge, and held in position by the end of the stout paper cartridge case turned over against it. After firing, the pellets disperse soon after their exit from the barrel, and this dispersion increases with the range. The degree of dispersion can be controlled to some extent by a 'choking' device near the termination of the barrel. This takes the form of a slight construction which varies in degree in different weapons. To describe this, such terms as 'full choke' and 'half choke' are used. In certain weapons there is no 'choke' device. If a shot is fired close to the body surface, up to a few inches, the shot enters as en mass, and in addition the liberated gases and flame lacerate the tissues, which show evidence of burning, carbon deposit, and powder tattooing. The wads may be forced into the wound, and this may prove an important clue to the class of cartridge used. When the gun has been fired at from 1 to 3 feet from the body, a more or less irregularly circular wound about $1^1/_2$ to 2 inches in diameter will be produced ....*

There will be evidence of some degree of scorching, carbon deposit, and tattooing. So far as dispersion is concerned, with a 'half-choke' gun the pellets will show a spread of about 5 inches in diameter at a range of 5 yards, about 12 inches in diameter at 10 yards, about 16 inches in diameter at 15 yards, and about 20 inches in diameter at 20 yards. To determine the dispersion at the same ranges with a gun of 'full choke' an approximate method is to deduct a quarter from the measurements of these diameters of spread. At a range of over a yard and up to about 3 yards, evidence of burning disappears and probably only faint tattooing will be found. Beyond a yard, the entering shot produces an irregular wound, and, as the result of commencing dispersion of the pellets, individual pellet holes may be detected.

When smokeless powder is used, blackening and tattooing will be less marked at all ranges than with black powder.

Accurate estimations of the pellet patterns at different ranges are not possible, since so much depends upon the idiosyncrasies of individual cartridges. This is due to the fact that the cardboard wad is so frequently dislodged in an oblique fashion that turbulence of the shot occurs within the barrel and thus affects the pellet patterns at other than close ranges. With regard to the size of the area of wounding produced by a sporting gun, almost irrespective of choke, an approximate estimate, at different ranges, may be obtained by using this simple formula:

If X = range in yards, then the diameter of the wounds = (X+1) inches.

It should be clearly understood, however, that the dimension of the area of wounding, as calculated in the foregoing, is that of the cone of the shot spread, measured on a plane perpendicular to the line of fire and upon a relatively flat surface.

Taylor in his famous work entitled *"Principles and Practice of Medical Jurisprudence"* (1965 Edn.), states at page 283:—

Shotguns fire a charge of lead pellets which, if fired from a full 'choked' (narrowed) cylinder spread to a pattern which, measured in inches, is about the same as the distance in yards.

And again at page 295—

> *As the amount of 'choke' or narrowing of the bore is of importance in keeping a shot charge together, it is vital to know which barrel has been fired. Discharges from unchoked barrels may begin to spread at 2 or 3 feet from half-choke at 3 or 4 and full-choke at 5 or 6 feet.*

At page 296 he adds—

> *Whatever the nature of the charge or projectile, a portion of the powder always escaped combustion at the time of discharge and each grain then acts like a minute projectile, contusing the skin, producing ecchymosis and often lacerating it if the weapon is fired at a close range. The clothing may be burnt, and the skin scorched by the flame of hot gas, and particles of powder may be actually driven into the skin causing 'tattooing'. Powder marks are more easily seen when the older black powder is used. Smokeless powders are more completely burnt, and leave, as a rule, less deposit. The grains being colourless are less easily detected, and may entirely escape observation unless a hand lens is used. We may assume that marks of burning, or blackening, or of tattooing from powder indicate that the weapon was fired from a near distance, certainly within arm's reach.*

All the three authors above quoted appear to unanimous that in judging the distance from which a firearm was discharged, the appearance and nature of the resultant wound cannot be said to afford a sure criterion and that any deductions based thereon would lead at best to a very rough estimate.

We have given our most careful consideration to the medical evidence in the light of the above quoted authorities on medical jurisprudence, the deposition of Dr. B.R. Sharma and the contention of Mr. Sibal and our conclusion is that the latter cannot prevail and that the opinion of the ballistic expert, substantially in accord as it is with the said authorities, deserves acceptance. It is true that if the edges of the wound covered by injury No. 2 were found charred, that injury could not have been caused by the same shot from which resulted injuries Nos. 1 and 4, these two injuries, according to Dr. Sharma, having been the result of fire from a range of 3 to 8 feet. It must be held, however, that it was the contusing effect of the impact of the projectile or the dirt ring around the wound covered by injury No. 2 that was mistaken for charring; for, as pointed out by Dr. B.R. Sharma (C.W. 1), injuries Nos. 2 and 3 could not have been caused by a separate shot inasmuch as such a shot would have produced a larger entrance wound and should also have resulted in more than one exit wounds. The dimensions of the wounds covered by injuries Nos. 2 and 3 unmistakably indicate that these wounds were caused most probably by a single pellet and such a pellet would properly be relatable to the shot which caused injury No. 1. In this connection reference may be made not only to the proximity to each other of injuries Nos. 1 and 2 but also to the fact that only two pellets were recovered from inside the

head of the deceased, a fact indicative of the rest of the charge from the shot not having gone into the entrance wound covered by injury No. 1, even though the wads were all recovered from the occipital region. These factors, about the existence of which there can be no doubt, show that the charge did not enter *en masse* but had spread to some extent at the stage of impact and are incompatible with the existence of charring in the case of injury No. 2.

It further clearly appears that the "small pellet" which the doctor (P.W. 2) claims to have found embedded in the centre of the three wounds comprising injury No. 4 was nothing more than dried blood and all the pellets which had caused these wounds had skipped the shoulder. This follows not only from the fact that only pieces of dried blood (and no pellet) are contained in the relevant phial but also from the relative position of the wounds on the shoulder part of the shirt of the deceased. And if this be so, it cannot be said that the pellets, which caused the three wounds just above-mentioned had lost most of their momentum by the time they struck the deceased and had, therefore, been fired from long range.

And once this conclusion is reached and the charring part of injury No. 2 is ignored, no improbability attaches to injuries Nos. 1 to 4 having resulted from a single shot. If the ammunition used by the assailant was an L.G. cartridge and the victim's face was turned towards the left, his shoulder being the part of the body nearest to the muzzle of the gun, part of the charge (three pellets) could well have grazed the shoulder and ran past it through the shirt, another pellet could have gone into the left cheek and out at the seat of injury No. 1 along with the wads, breaking the jaw and getting lodged, after deflection, in the occipital region; so that in such a situation injuries Nos. 1 to 4 would be just the injuries that would result.

In so far as injury No. 5 is concerned, we have not the slightest hesitation in holding that the doctor's opinion about the diameter of the missile which caused it being an inch or so, is wholly unreliable; nor has Mr. Sibal been able to give us the description of any weapon from which such a missile was likely, in the circumstances of the case, to have been discharged. On the other hand, as pointed out by Dr. B.R. Sharma (C.W. 1), the injury could have been caused by fire from a shotgun, the range being such that the charge would enter en masse. It is no doubt true that according to Dr. Sharma, the injury should have been marked by tattooing and blackening. But then we are not very sure if the doctor (P.W. 2) conducted the autopsy with such care as not to have missed noticing tattooing and blackening in the case of injury No. 5 if it was actually there; nor are we convinced that tattooing or blackening was really present in the case of injury No. 5 such as may have been capable of detection by the naked eye. As pointed out above in one of the passages cited from Taylor's work, marks left by unburnt smokeless powder which is colourless are less easily detected "and may entirely escape observation unless a hand lens is used".

It has also to be borne in mind that the charge would enter *en masse* and produce a wound of the type of injury No. 5 even if the shot causing it is fired from a range of about 6 feet provided the barrel used is a full-choke barrel and in such a case the chances of the presence of detectable tattooing may not be

very bright. In this view of the matter we hold that injury No. 5 could well have been caused by a charge proceeding from a shotgun and that the recovery of only a single pellet such as could have formed part of that charge from inside the body of the deceased is attributable only to the autopsy being not as thorough as it should have been.

1.20 Murder and Death Sentence[1]

As a mere proposition of law, it would be difficult to accept the argument that the sentence of death can be legitimately imposed only where an accused person is found to have committed the murder himself. Whether or not sentences of death should be imposed on persons who are found to be guilty not because they themselves committed the murder, but because they were members of an unlawful assembly and the offence of murder was committed by one or more of the members of such an assembly in pursuance of the common object of that assembly, is a matter which has to be decided on the facts and circumstances of each case. In the present case, it is clear that whole group of persons belonged to Laxmi Prasad's faction, joined together armed with deadly weapons and they were inspired by the common object of exterminating the male member in the family of Gayadin. Ten of these persons were armed with firearms and the others with several other deadly weapons, and evidence shows that five murders by shooting were committed by the members of this unlawful assembly. The conduct of the members of the unlawful assembly both before and after the commission of the offence has been considered by the courts below and it has been held that in order to suppress such fantastic criminal conduct on the part of villagers it is necessary to impose the sentences of death on 10 members of the unlawful assembly who were armed with firearms. It cannot be said that discretion in the matter has been improperly exercised either by the trial court or by the High Court. Therefore, I see no reason to accept the argument urged by Mr. Sawhney that the test adopted by the High Court in dealing with the question of sentence is mechanical and unreasonable.

1.21 Injuries as Evidence[2]

The learned counsel further contends that it was doubtful that 12 rounds would have been fired. He points out the number of injuries received by the villagers. But these injuries support the prosecution story. From the injuries on the various persons examined by Dwarka Nath Prasad, P.W. 41, apart from the persons who had died and whose bodies had been held to have been cremated by unidentified persons, it appears that 20 persons had received gunshot injuries; one of them had as many as 14 lacerated wounds and another had 10 lacerated wounds. Apart from that there is no reason to doubt the oral evidence given in this case that a number of rounds were fired.

1.22 Number of Guns[3]

Neither the genuineness of the recoveries of the empties from the roof of the house of Bhag Singh nor the recovery of gun Ex. P. 12 from the person of

1. *Masalti* v. *State of Uttar Pradesh*, 1965 (I) Cr LJ 226: AIR 1965 SC 202.
2. *Ram Prasad Sharma* v. *State of Bihar*, 1970 Cr LJ 496: AIR 1970 SC 326.
3. *Bhag Singh* v. *State of Punjab*, 1971 Cr LJ 903 (P&H).

Bhag Singh at the time he was apprehended has been challenged on behalf of the defence nor the correctness of the opinion given by the ballistic expert has been challenged on its behalf. It has, however, been urged by Shri Dara Singh, counsel for the appellants that according to the statement given by Shri J.K. Sinha, Assistant Director, Forensic Science Laboratory, Chandigarh P.W. 20, who examined and tested the three empty cartridges, Ex. P 13/1.3 recovered from the roof of the house of Bhag Singh appellant, they were fired from gun, Ex. P. 12 used by Bhag Singh appellant and that no empty cartridge has been recovered used in the gun, with which Mehar Singh appellant was armed and with which, according to the evidence of the eye-witnesses, he fired one shot at Basant Singh deceased. The question of recovery of empty cartridge dropped from the gun of Mehar Singh appellant will arise only, if there is evidence to show that after Mehar Singh fired his shot at Basant Singh deceased he emptied his gun. It is nowhere stated by any of the eye-witnesses, and no such question was asked from them in course of their cross-examination, that after Mehar Singh had fired his shot he emptied the gun.

1.23 Post-mortem Report Evidence[1]

As stated in the post-mortem examination report, the doctor found that 2 cms. of the upper lid of left eye of the deceased was missing, contents of the left eye were completely destroyed and were bulging out. The roof of the orbit was found shattered into pieces. On opening the skull, the doctor found congestion in the left frontal region of the brain. The left frontal lobe of the brain substance was found damaged and a metallic shot was found in the brain substance, 5 cms. above the roof of the orbit. The doctor also found a wound of entrance on the left side of the face, 4 cm lateral to left exit, all in the horizontal line. The wound was irregularly circular and measured 1 X 1 cm. The shot had travelled through the muscles and was found in the sub-mastoid region, lodged in blood clot. The doctor further found two gunshot wounds of entrance and two corresponding gunshot wounds of exit on the front of the abdomen. The first entrance wound was in the right lumbar region, 11 cm. above the anterior superior iliac supine and 4.5 cms. lateral to the umbilicus. The wound was irregularly circular, the margin was found inverted and measured 1 X 1 cm. It had a corresponding wound of exit situated on the right lid region in the middle auxiliary line 9.5 cms. away from the wound of entrance. The second wound of entrance on the abdomen was in the lumber region 14 cms. above the anterior, superior iliac supine and 5 cms. laterally. The wound was irregularly circular, margins were inverted and measured 1 X 1 cm. According to the doctor, the cause of the death of the deceased was damage to the brain substance caused by the gunshot which entered at No. 1 on the left eye. The doctor extracted two pellets (Ex. P-6) and (Ex. P-7) from the dead body and sent them in a sealed phial to the police who took it into possession, *vide* Ex. PG-1.

The 12 bore gun and the empty cartridge seized by the police, were sent to the Forensic Science Laboratory, Chandigarh, on March, 24, 1972, where they were received on April 10, 1972. Dr. J.K. Sinha, Forensic Expert, examined these

1. *State of Jammu & Kashmir* v. *Hazara Singh,* 1980 Cr LJ 1501.

articles and reported that 12 bore SBBL gun (Ex. P-1) had been fired through; that the firing pin of the said gun appeared to have been tampered with; and that no other characteristic marking was observed to identify or connect the empty cartridges with the 12 bore gun (Ex. P-1).

The prosecution story that the second shot was fired at the deceased by Piyara Singh stands negatived by the evidence of Dr. J.K. Sinha, Ballistics Expert. According to the complainant and other eye-witnesses, the second shot was fired at the deceased by Piyara Singh from a distance of about 24 yards, while the first shot had been fired from 18 to 20 yards. According to the Ballistics Expert, the dispersion of the pellets which hit the eye and face was such smaller as compared to the dispersion of the pellets causing injuries at the abdomen. According to the Ballistics Expert, the possibility of all the gunshot injuries found on the deceased, having been caused by one gun-fire, could not be excluded.

1.24 Close Range Phenomena[1]

On 13.12.1999 at about 06.30 a.m., the deceased was milking a buffalo. His other family members including the wife of his brother (informant Krishna Deo Prasad-PW-7), nephew Sunil Prasad and others were brushing their teeth at the roof of their house. Brijnandan Prasad and others have their joint residential house at some distance from the house of the deceased. They allegedly came over the roof of their house armed with rifles and started brick-batting and abusing the brother of the informant alleging that they had burnt a heap of straw belonging to them. When Shivnandan Prasad went to the roof of the house, allegedly the appellants started firing. One of the bullets hit Shivnandan Prasad on his chest. An alarm was raised. The first informant reached near his brother and found him dead. A First Information Report was lodged at about 10.00 a.m. on the same day before Chandi Police Station.

* * * * *

The learned Sessions Judge relying on or on the basis of the evidence adduced by the prosecution and in particular the deposition of the eye-witnesses found the appellants guilty of commission of an offence under section 302/34 of the Indian Penal Code and sentenced them to undergo rigorous imprisonment for life. A fine of Rs.5,000 was also imposed upon each of them. They were also found guilty under section 27 of the Arms Act and were convicted to undergo rigorous imprisonment for one year. The appeals preferred by the appellants have been dismissed by a Division Bench of the High Court.

So far as the contention in regard to distance of firing is concerned, it is true, ordinarily, charring would take place, if firing is done from a distance of less than four feet, as has been noticed in some of judgments of this Court in *Subhash* v. *State of Uttar Pradesh,* (1976) 3 SCC 629; *Nath Singh* v. *State of Uttar Pradesh,* (1980) 4 SCC 402; *State of Punjab* v. *Wassan Singh,* (1981) 2 SCC 1 and *Sidharth* v. *State of Bihar,* (2005) 12 SCC 545.

In some cases, medical evidence may corroborate the prosecution witnesses; in some it may not. The court, however, cannot apply any universal rule whether ocular evidence would be relied upon or the medical evidence, as the same will

1. *Baso Prasad* v. *State of Bihar,* 2007 AIR SCW 807.

depend upon the facts and circumstances of each case. No hard and fast rule can be laid down therefor.

It is axiomatic, however, that when some discrepancies are found in the ocular evidence *vis-a-vis* medical evidence, the defence should seek for an explanation from the doctor. He should be confronted with the charge that he has committed a mistake. Instances are not unknown where the doctor has rectified the mistake committed by him while writing the post-mortem report.

(in the instant case) Whereas in the body of the post-mortem report, the medical expert stated, 'the margin of wound charred and inverted' at another point, he in no uncertain terms stated that firing was done from long range and distance of firing would be from more than six feet. The possibility, therefore, of his commission of some mistake in the post-mortem report cannot be ruled out. It was on the said premise, it was incumbent upon the defence to bring the said fact to the notice of the doctor. Probably, knowing the futility of asking such a question, no such contention was raised either before the Sessions Judge or before the High Court. No such ground has also been taken before us.

Tattooing or charring shall depend upon the constituents of the propellant charge. It is in that context only wounds are classified by their external appearance as close contact, near contact and distant. The doctor in his evidence was categorical in stating that the wounds would not come within the purview of classification of near contact; but the wounds should be classified under 'distant contact'.

The authorities like Taylor and HWV Cox in their treatises, state in details as to how the post-mortem examination should be conducted.

The nature of the gun will also have a role to play. Unfortunately, the investigating officer did not make any attempt even to seize the gun. When the weapon was not seized, the question of examination of any ballistic expert would not arise. [See: *Nirmal Singh* v. *State of Bihar,* (2005) 9 SCC 725].

2. BALLISTICS EXPERT

2.1 Who is Expert?[1]

The law of evidence is designed to ensure that the court considers only that evidence which will enable it to reach a reliable conclusion. The first and foremost requirement for an expert evidence to be admissible is that it is necessary to hear the expert evidence. The test is that the matter is outside the knowledge and experience of the lay person. Thus, there is a need to hear an expert opinion where there is a medical issue to be settled. The scientific question involved is assumed to be not within the court's knowledge. Thus cases where the science involved, is highly specialised and perhaps even esoteric, the central role of an expert cannot be disputed. The other requirements for the admissibility of expert evidence are:

(i) that the expert must be within a recognised field of expertise,

(ii) that the evidence must be based on reliable principles, and

(iii) that the expert must be qualified in that discipline.

1. *Romesh Chandra Aggarwal* v. *Regency Hospital Ltd.*, (2009) 9 SCC 709.

(See *Errors. Medicine and the Law*, Alan Merry and Alexander McCall Smith, 2001 Edn., Cambridge University Press, p. 178.)

Section 45 of the Evidence Act, 1872 speaks of expert evidence. It reads as under:

> ***5. Opinions of experts.***—When the Court has to form an opinion upon a point of foreign law, or of science, or art, or as to identity of handwriting or finger impressions, the opinions upon that point of persons specially skilled in such foreign law, science or art, or in questions as to identity of handwriting or finger impressions are relevant facts.
>
> Such persons are called experts.
>
> *Illustrations*
>
> (a) The question is, whether the death of *A* was caused by poison.
>
> The opinions of experts as to the symptoms produced by the poison by which *A* is supposed to have died, are relevant.
>
> (b) The question is, whether *A*, at the time of doing a certain act, was, by reason of unsoundness of mind, incapable of knowing the nature of the act, or that he was doing what was either wrong or contrary to law.
>
> The opinions of experts upon the question whether the symptoms exhibited by *A* commonly show unsoundness of mind, and whether such unsoundness of mind usually renders persons incapable of knowing the nature of the acts which they do, or of knowing that what they do is either wrong or contrary to law, are relevant.
>
> (c) The question is, whether a certain document was written by *A*. Another document is produced which is proved or admitted to have been written by *A*.
>
> The opinions of experts on the question whether the two documents were written by the same person or by different persons, are relevant."

The importance of the provision has been explained in *State of Himachal Pradesh* v. *Jai Lal*[1]. It is held, that, section 45 of the Evidence Act which makes opinion of experts admissible lays down, that, when the court has to form an opinion upon a point of foreign law, or of science, or art, or as to identity of handwriting or finger impressions, the opinions upon that point of persons specially skilled in such foreign law, science or art, or in questions as to identity of handwriting, or finger impressions are relevant facts. Therefore, in order to bring the evidence of a witness as that of an expert it has to be shown that he has made a special study of the subject or acquired a special experience therein or in other words that he is skilled and has adequate knowledge of the subject.

It is not the province of the expert to act as Judge or Jury. It is stated in *Titli* v. *Alfred Robert Jones*[2] that the real function of the expert is to put before the court all the materials, together with reasons which induce him to come to the conclusion, so that the court, although not an expert, may form its own judgment by its own observation of those materials.

An expert is not a witness of fact and his evidence is really of an advisory character. The duty of an expert witness is to furnish the Judge with the necessary

1. (1999) 7 SCC 280: 1999 SCC (Cri) 1184.
2. AIR 1934 All 273.

scientific criteria for testing the accuracy of the conclusions so as to enable the Judge to form his independent judgment by the application of these criteria to the facts proved by the evidence of the case. The scientific opinion evidence, if intelligible, convincing and tested becomes a factor and often an important factor for consideration along with other evidence of the case. The credibility of such a witness depends on the reasons stated in support of his conclusions and the data and material furnished which form the basis of this conclusions. [See *Malay Kumar Ganguly* v. *Dr. Sukumar Mukherjee,* (2009) 9 SCC 22: 2010 AIR SCW 769, para 34].

In *State of Maharashtra* v. *Damu*[1], it has been laid down that without examining the expert as a witness in court, no reliance can be placed on an opinion alone. In this regard, it has been observed in *State (Delhi Admn.)* v. *Pali Ram*[2] that "no expert would claim today that he could be absolutely sure that his opinion was correct, expert depends to a great extent upon the materials put before him and the nature of question put to him".

In the article "Relevancy of Expert's Opinion" it has been opined that the value of expert opinion rests on the facts on which it is based and his competency for forming a reliable opinion. The evidentiary value of the opinion of an expert depends on the facts upon which it is based and also the validity of the process by which the conclusion is reached. Thus the idea that is proposed in its crux means that the importance of an opinion is decided on the basis of the credibility of the expert and the relevant facts supporting the opinion so that its accuracy can be cross-checked. Therefore, the emphasis has been on the data on the basis of which opinion is formed. The same is clear from the following inference:

> *"Mere assertion without mentioning the data or basis is not evidence. Even if it comes from an expert. Where the experts give no real data in support of their opinion, the evidence even though admissible, may be excluded from consideration as affording no assistance in arriving at the correct value."*

2.2 *Bonafide* of Expert[3]

Mr. Prasad's contention is that it has not been established in the case that P.W. 6 was entitled to claim that he was an expert so that his evidence could be made admissible. Prosecution had not asked any question so as to indicate that he had sufficient training, knowledge and experience as to justify him to be called an expert and, as such, it is urged that his opinion could not be the last word on the subject. This part of the submission cannot be accepted, because no challenge was made in cross-examination. Besides, it is for the court to decide the question of competency or fitness of a witness who claims to be an expert. In this case I am satisfied that the learned judge before whom P.W. 6 was examined appears to have been satisfied that he was firearms expert under government of Bihar, therefore, his competency cannot be now questioned at this stage.

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1. AIR 2000 SC 1691.
2. AIR 1979 SC 14.
3. *State of Bihar* v. *Hanuman Koer,* 1971 Cr LJ 187 (Pat).

The next question that, however, still remains to be determined is the value of the evidence of P.W. 6. Learned counsel has contended that the record does not furnish the materials which had helped the expert in coming to his conclusion as he has done in this case and the court has not the advantage of looking into those materials so as to hold that the expert was justified in the opinion that he has given. Besides, if the said other materials have not been produced and as such, there can be no guarantee that the expert had either examined the gun and the cartridge with the help of those materials at all. If, on the other hand, he had so done, whether his conclusions had been rightly arrived at.

2.3 Vacillating Expert[1]

It is well-settled law that evidence of witnesses to the occurrence cannot be thrown overboard merely because they are interested and partisan witnesses. All that the law demands is that their evidence should be scrutinised with great care and caution to safeguard against the normal temptation to falsely implicate others. The trial court had adopted that approach in evaluating the evidence of the eye-witnesses. On a critical examination of their evidence it concluded that their evidence stood corroborated by medical evidence, in that, it disclosed that Ali Mohammad had received as many as 18 injuries (13 incised wounds, 2 gun shot wounds, 2 abrasions and one contusion) whereas the deceased Siraju had sustained five injuries (four incised wounds and a swelling). The evidence of P.W. 1 also stood corroborated by the evidence of P.W. 6 Zafaruddin who wrote the FIR Ex. Ka. 3 at the behest of P.W. 1. The contents of the FIR also corroborate the testimony of P.W. 1. The find of blood, etc., from the scene of occurrence noted in the Panchnama proved through P.W. 7. Om Prakash also lends corroboration to their testimony. It was, therefore, contended that the High Court failed to come to grips with the evidence and approached the matter in a perfunctory manner.

The deceased Ali Mohammad had, as stated earlier, suffered as many as 18 injuries. Injuries Nos. 12 and 13 are described as gunshot injuries. They read as under:—

> Injury No. 12:—*4 circular gunshot wounds of entry 3/4 cm. x 3/4 cm. with abraded margins on top of nose and right side of cheek near nose in an area of 5 cm. x 5 cm. No tattooing or blackening.*
>
> Injury No. 13:—*One circular gun shot through and through wound of entry x exist wound 3/4 cm. x 3/4 cm. on right side upper lip. No tattooing or blackening.*

These two injuries are undoubtedly gun-shot injuries. Dr. Mathur, who performed the post-mortem, states that these injuries could be caused if fired at from a distance of over 4 feet. There were corresponding holes in the shirt worn by the victim. This medical officer does not say that the aforesaid two injuries were possible by a single shot. However, Shri Badul Rai, the ballistic expert, opined that the said two injuries could have been caused by a single shot fired from a country-made pistol. He deposed that if the shots were fired from

1. *Anvaruddin* v. *Shakoor*, 1990 Cr LJ 1269 (SC).

a short distance of 8 to 10 feet all the pellets would have entered to body *en masse* and would have caused an exit wound thereby discrediting the evidence of the three witnesses that the shots were fired from 2½ to 3 yards. The witness, however, admitted that his estimate regarding the distance from which the shot was fired was based on standard ammunition and not country-made weapons. But when cross-examined, he stated that the single shot must have been fired from a country made weapon from a distance of eight feet. The fact that there was no tattooing or blackening is indicative of the fact that the shots were fired from not too short a distance. The High Court took no notice of Dr. Mathur's opinion in this behalf. The evidence of the three eye-witnesses as to the distance from which the shots were fired is a mere estimate. Even though the ballistic expert initially opined that injuries Nos. 12 and 13 could be the result of a single shot he vacillated and stated that the possibility of the said two injuries having been caused by two different shots could not be ruled out altogether. He merely stated that the greater probability was that they were the result of a single shot. In other words, the ballistic expert was not positive in his view. In this nebulous state of the evidence of the ballistic expert we are of the view that the High Court was wholly wrong in doubting the direct evidence of the three eye-witnesses on this ground. Where the expert evidence is obscure and oscillating, it is not proper to discredit the direct testimony of the eye-witnesses on such uncertain evidence. In such a situation unless the evidence of the eye-witnesses is shaken by some glaring infirmities, it would not be proper to doubt the correctness of their statements. We are, therefore, of the opinion that the High Court was wrong in its conclusion based on the vacillating evidence of the ballistic expert.

2.4 Doctors not Ballistics Experts[1]

2. Satyavir Singh, appellant-accused was tried for an offence under section 307 of the Indian Penal Code, 1860 (hereinafter referred to as the 'Code') and section 25/27 Arms Act, 1959 (for short the 'Act') in the Court of Assistant Sessions Judge, Bulandshahr, and was found guilty for both the offences. After hearing the accused on the question of sentence, the Court awarded him three years R.I. under section 307 of the Code and one year R. Inder section 27 of the Act. Both the sentences were ordered to run concurrently. Upon appeal by the accused, the learned 1st Additional Sessions Judge at Bulandshahr set aside the judgment and sentence and while partly allowing the appeal by its judgment dated 06.11.1980 acquitted him of both the charges for which he was convicted by the learned Assistant Sessions Judge, Bulandshahr and only convicted him for offence under section 25(1)(a) of the Act and sentenced him to imprisonment till the rising of the Court. With the leave of the High Court, the State preferred an appeal against the judgment of acquittal. The High Court of Judicature at Allahabad *vide* its judgment dated 20.10.2008 set aside the order of acquittal and while allowing the appeal partly, it convicted the appellant under section 307 of the Code and declined to interfere with the sentence awarded by the First Appellate Court in relation to an offence under section 25 of the Act.

1. *Satyavir Singh* v. *State of Uttar Pradesh,* 2010 Cr LJ 1659.

3. Legality and correctness of the judgment and order of sentence passed by the High Court is questioned by the appellant-accused in the present appeal under Article 136 of the Constitution of India *inter alia* but primarily on the following grounds:

(a) The High Court has erred in law in setting aside the judgment of acquittal recorded by the First Appellate Court, which was reasoned one and based on a proper appreciation of evidence. Thus the High Court ought not to have upset the judgment of acquittal. Therefore, the High Court has acted beyond the limitations on such exercise of power and heavy reliance is placed on the case of *Ganesh Bhavan Patel* v. *State of Maharashra*, (1978) 4 SCC 371.

(b) No motive was proved and in absence of a specific motive, the High Court has erred in holding that the appellant is guilty of offence under section 307 of the Code.

(c) The expert evidence being at variance and the medical evidence not supporting the injuries allegedly found on the person of the victim, the benefit of doubt should have been given to the accused as the prosecution had failed to prove its case beyond reasonable doubt.

(d) The Court should have appreciated that it was an accidental firing and the prosecution had not put forth any explanation on record as to how the weapon (double barrel gun) was broken.

5. Facts: Bhanu Prakash Sharma, (PW-1) was taking tea at Hamid Khan's Hotel at about 2.30 P.M. His brother Dharam Prakash (PW-3) arrived at the crossing towards Narora Bus Stand. Dharam Prakash aged about 18 years was a student of Khurja Polytechnic. Satyavir Singh, accused is the resident of village Niwari. Vijay Singh is his elder brother and owned a double barrel gun under a valid licence. It is the case of the prosecution that the fields of farmers in village Niwari were irrigated by tubewell of Prem Shankar Thakur. A road was constructed for the power house due to which some farmers of village Niwari started irrigating their fields from the tube well of Bhanu Prakash Sharma (PW-1), resident of village Jairampur Bangar. This caused some displeasure to Prem Shankar Thakur, father of Satyavir Singh, the accused. At about 2.30 P.M. on 09.02.1975 said Bhanu Pratap sharma was taking tea in the Hotel of Hamid Khan at Chauraha of the village. Dharam Prakash came from the side of Narora Bus Stand. The accused on seeing Dharam Prakash, who ultimately examined as PW-3, challenged him by saying that how he was irrigating the fields of villagers from his tube-well. The accused, as already noticed, was armed with a licenced gun of his brother. The accused thereupon fired two bullets from that gun on Dharam Prakash.

Dharam Prakash was medically examined on that very day by Dr. Suresh Chandra Singh (PW-5) and the following injuries were noticed on his person:

'INJURIES:

(1) Lacerated wound 1 cm. X 1 c.m. X thickness of the left upper arm, on the left upper arm front aspect in upper part. There are four abrasions each

1/4c.m. X 1/4c.m. on its lower and outer aspect. Suspected underneath Adv. X-ray.

The margins of the wound are inverted.

(2) Lacerated wound 1.5 c.m. X 1.5 c.m. X thickness of the left upper .. on the back aspect of the left upper arm 2 c.m. Above the elbow... Suspected underneath. Adv. X-ray. The margins of the wound are inverted.

(3) Lacerated wound 7.5 c.m. X 3.5 c.m. on the left forearm upper half-inner aspect. It is bone deep. Suspected fracture underneath. Adv. X-ray.'

18. These findings were set aside by the learned First Appellate Court which stated that it was an accidental firing and the prosecution has failed to prove its case. The benefit was given to the accused primarily on certain surmises and conjectures and doubting the presence of the witnesses particularly Ram Shankar whose presence had been admitted by the accused himself in the report lodged by him and even in his explanation before the Court.

19. Definite doubts or lacunae in the case of the prosecution may result in benefit of doubt being given to the accused and consequential acquittal. However, such doubts and lacunae must be clearly distinguished from doubts or lacunae based upon certain assumptions. In such cases what appears to be loop-hole in the case of the prosecution at the first glance, on appropriate examination and appreciation of evidence, may fall in the other class. The following observations of the learned First Appellate Court clearly demonstrates that Court has founded its judgment of acquittal more on surmises and suspicion and the views of the Court which were not supported by evidence on record.

Illustratively, the following observations can usefully be noticed:

"(a) It is evident that left arm is not a vital part. If appellant was fired from a close range within 4 feet, he could have easily aimed at the chest of the victim, which could have killed him at the spot.

(b) But when the motive alleged is the very genesis or commencement of the prosecution story, it would not be possible to discard the defect relating to motive or genesis in the prosecution story.

(c) The third important feature of the case is simultaneous presence of Bhanu Prakash, Dharam Prakash and Ram Shanker at the crossing.

(d) Then the only possible inference is that they were together at the crossing or at the tea stall for some other reason and as soon as they saw appellant Satyavir Singh, a youngman alongwith a gun, they were tempted to snatch the gun.

According to medical evidence the very seat of the injuries discloses that the shots would have been fired during snatching."

20. The above observations demonstrate that the learned First Appellate Court has proceeded on the basis of certain presumptions which in the opinion of the Court could be the correct approach. But such approach may be guided by the doctrine of perversity. If findings are neither supported by evidence nor such

approach could be adopted by the person of common prudence or behaviour, then the court may interfere in a judgment of acquittal. The First Appellate Court is a court of both fact and law and as such has jurisdiction to entirely re-appreciate the evidence. Thus, while setting aside the order of conviction it has to equally ensure that no injustice is done and on certain assumptions of facts, guilty may not go scot free. A person otherwise is proved to be guilty by the prosecution by leading cogent and reliable evidence, normally would not be given the benefit of doubt on the basis of certain assumptions or presumptions of facts. The Court may have to notice and rely upon behaviour of the person of a common prudence only where the direct evidence have been produced. As we shall shortly proceed to discussion that the assumptions raised by the First Appellate Court are not supported on record. We find that the High Court has not fallen in error of law in setting aside the order of acquittal and affirming the judgment of conviction rendered by learned trial court.

21. Now we may proceed to examine the appreciation of evidence on record by the First Appellate Court acquitting the accused as well as that of the High Court reversing the judgment of acquittal.

22. The High Court noticed that the fields of farmers in village Niwari were irrigated from the tubewell of Prahalad Singh Thakur which was installed in that village. It was because of construction of the road for the Power House that the farmers of village Niwari started irrigating from the tubewell of Bhanu Prakash Sharma resident of Village Jairampur Bangar. This was not bearable to the accused who is the son of Prahalad Singh Thakur. Thus, this may not be exactly a motive but was a reason enough for the accused to take an offensive step against the injured.

23. The first information report was lodged by Bhanu Prakash Sharma without any delay and as already noticed Dharam Prakash (PW-3) had been challenged by the accused saying that how he was irrigating the fields of the villagers of his village from his tubewell. Armed with a licensed gun of his brother, he opened fire on Dharam Prakash and shot two bullets. The occurrence was seen by Bhanu Prakash Sharma (PW-1), who was present there as well as Rama Shankar (PW-4) and some others. The accused was arrested and the gun was also deposited. Ext.Ka-1 report to the police station was lodged by Bhanu Prakash Sharma (PW-1).

24. Dharam Prakash was medically examined on 9th February, 1975 at about 4.35 p.m. and according to Dr. Suresh Chandra Singh (PW-5), three injuries were found on the person of the injured who was then subjected to X-Ray by Dr. A.K. Agarwal (PW-8), who was posted as Radiologist in District Hospital, Bulandshahr. It has been proved on record by Dr. Jitendra Singh Sharma (PW-7) that Dharam Prakash remained in the hospital from 9th February, 1975 to 20th March, 1975.

25. The medical evidence clearly reflected that the injuries could be caused by gun shots. However, there was little difference of opinion between two doctors but both these doctors are not ballistics experts so as to provide any expert opinion which could safely be relied upon by the Court while deciding the case.

26. The difference of opinion between experts necessarily may not persuade the Court to adopt one approach or the other particularly when none of the experts are persons competent to express opinion on that subject. The difference of opinion between two doctors which, in the facts and circumstances of the present case, does not have any material bearing on the case of the prosecution is not such a formidable submission which has to be accepted by the Court to grant necessarily the benefit of doubt to the accused.

It was stated by Dr. Suresh Chandra Singh (PW-5) that such injuries could be caused by gun shots. The trial court and the High Court expressed in unambiguous language the view that it was possible that no gunpowder was traced around the wounds of the injuries as he was wearing clothes. This finding cannot be said to be erroneous. Dr. A.K. Agarwal (PW-8) clearly stated that the pellets of the fire shots were found in the wounds and were duly seen in the X-Ray of the injured. Thus such view taken by the courts cannot be faulted. In fact the major part of the occurrence is not even disputed by the accused in his statement under section 313 of Cr.P.C. and in any case the report lodged by him bearing No. 27A/75 clearly shows that the incident occurred and the injured besides, other two witnesses, PW-1 and PW-2 were present at the spot. In fact according to the accused it was an accidental fire which occurred as a result of snatching of the gun by the injured and other persons accompanying him at that time. While, according to the prosecution he had fired two shots which injured the victim and thereafter the gun was snatched. Dr. Suresh Chandra Singh (PW-5) examined the injuries of the injured and stated that injuries would have been caused 2-3 hours earlier and that when the injured was brought to the hospital he was bleeding and such injuries could be sustained by gun shots. This statement of the doctor had fully supported the case of the prosecution and chain of events as stated therein.

29. With considerable emphasis, learned counsel for the appellant argued that as no explanation was rendered by the prosecution as to how the gun had broken, this would straightaway cause serious dent in the case of the prosecution and entitles the accused for an acquittal.

30. We find no merit in the aforesaid contention. It was for the accused to prove his defence as the prosecution is liable to prove the case as stated in the first information report and the report filed by it under section 173 of Cr.P.C. The eye witnesses had actually seen the victim being injured by the shots fired by the accused. In fact the accused was apprehended at the spot with the gun. The gun in question was admittedly a double barrel gun and the same was used by the accused while firing two shots. The gun with the spent cartridges were taken into custody *vide* Ext Ka-3. The accused himself had lodged the report bearing No. 27A/75 under section 394 of the Indian Penal Code against the eye-witnesses including Bhanu Prakash Sharma, Dharam Prakash, Rama Shankar and one unknown person. The report lodged by the accused, itself shows as to how the gun was broken. But the breaking incident took place after the two shots had been fired by the accused upon the injured. There appears to be no justifiable reason as to why the eye witnesses PW-1 and PW-4, who even according to the accused were present at the place of occurrence, should

be disbelieved. It could be safely construed from the evidence on record that the accused may not have any strong motive to kill the victim, however, the loss of revenue on account of the fact that water for irrigation was being provided by the father of the injured, was reason enough for the accused to show his anger or it was not acceptable to him, as stated by the witnesses, thus he fired two shots which resulted in causing injuries to Dharam Prakash. Both the reports were lodged by the informant as well as the accused at 2.30 p.m. on 9th February, 1975. The gun and the utilized bullets were given at the police station itself. This evidence clearly shows that prosecution has not failed in proving its case in accordance with law.

31. As already noticed, part of the occurrence stands admitted and it is only the limited aspect of the case as to whether the firing was accidental or the accused had intentionally fired on the injured. Statement of the eye witnesses, medical evidence and the investigation conducted by the Investigating Officer clearly show that the prosecution has been able to prove its case beyond reasonable doubt. The act of firing gun shots at the injured obviously shows that the accused had the knowledge that by such an act he may even cause the death of the injured and actually caused hurt to victim. It is a matter of co-incidence that the gun shots did not injure Dharam Prakash at any of his vital organs.

32. Learned counsel appearing for the appellant while referring to certain discrepancies appearing in the statements of the witnesses including the doctors, vehemently contended that it was a case of acquittal and there was no intention on the part of the accused to kill the injured otherwise he would have fired the gun shots at the vital parts of the body of the injured, particularly when according to the prosecution, it is stated that the firing took place from a close distance. If that was so, such injuries would not have been caused. This contention also does not impress us inasmuch the tattooing and charring shall always depend upon the constituents of the propellant charge and it is in that context only wounds are classified by their external appearance as close contact. Reference can be made to *Bano Prasad* v. *State of Bihar*, 2006 (12) SCALE 354.

34. The cumulative effect of the above discussion is that we do not see any reason to interfere with the judgment of the High Court. The High Court has not exceeded its jurisdiction in law and with reference to the evidence on record while reversing the judgment of acquittal to one that of conviction. So far as the conviction of the accused under section 25(1) of the Act is concerned, no arguments were addressed. In any case we see no reason to interfere with the said finding of the courts below.

35. In the result, the appeal fails and is dismissed.

2.5 Medical Officer: No Ballistics Experts[1]

Put briefly the prosecution case is as follows:

On 19th February, 1977 at about 4.45 p.m. the accused Ram Samujh and Mahmood appellant No. 1 both armed with guns, Khalid-appellant No. 2, Bajrang

1. *Mahmood* v. *State of Uttar Pradesh,* 2008 Cr LJ 696 (SC).

and one unidentified person armed with lathi assaulted deceased Ram Singh at Galiyara near the fields of Ram Sewak Ahir, while he was returning to his village Badipur on his motorcycle. It was alleged that the accused Ram Samujh and Mahmood fired four shots, as a result of which the deceased fell down injured and thereafter Khaliq snatched the licensed revolver belonging to the deceased and all the five fled away from the scene. Ram Singh died on the spot. The incident of murderous attack was witnessed by Jaikirat Singh (P.W. 1) who is none other than the son of deceased-Ram Singh, Ram Ratan (P.W. 2), resident of village Sujerpur hamlet of Bodipur and Ram Adhar (P.W. 3). P.W. 1 lodged written First Information Report Ext. Ka. 1 on the same day at 4.45 p.m. naming all the accused and the manner in which the murderous attack on the deceased had taken place. Jagdamba Prasad Dwivedi (P.W. 7) the office in-charge of Police station, Kothi rushed to the scene of offence at about 6.00 p.m. and found the dead body of Ram Singh and his motorcycle in galiyara near the fields of Ram Sewak Ahir. The broken pieces of the skull of the deceased and broken three teeth were seized from the place of occurrence. The discharged cartridge and tickli were also seized from the spot. P.W.7 after preparing the Inquest Report (Ext. Ka. 7) sent the dead body for conducting post-mortem. Dr. R.S. Katiyar P.W. 5 performed the autopsy on the dead body on 20th February, 1977 at about 9.45 a.m. and found as many as five ante-mortem gun shot wounds. A cap of cartridge was extricated from the brain of the deceased. Scalp bones were found fractured. It was found that vital organs like peritoneum, liver, kidneys were badly ruptured. In the opinion of the doctor, the cause of death was due to shock and hemorrhage resulting from ante-mortem injuries. The investigation of the case was transferred in the first week of March, 1977 to CBCID. Inspector M.L. Gautam having completed rest of the investigation submitted charge-sheet against the appellants and other accused.

The accused have denied the charges framed against them and took the plea that they have been falsely implicated due to enmity. The accused were accordingly put on trial. The prosecution in order to establish its case in altogether examined 8 witnesses and got marked 39 documents as Exts. Ka. 1-39. Amongst the witnesses examined by the prosecution, Jaikirath Singh, Ram Ratan and Ram Adhar (P.Ws. 1, 2 and 3) respectively were eye-witnesses to the murderous attack on the deceased. The accused also led evidence and examined Virendra Singh DW 1, Laxmi Narain Sinha DW 2 and Bindra Charan DW 3.

The learned Sessions Judge upon appreciation of the oral evidence and material on record found all the accused guilty of the charges framed against them and sentenced them to various terms of imprisonment. On appeal the High Court of Allahabad confirmed the conviction and sentences imposed by the learned Sessions Judge. The appellants who are accused No. 2 and 3 respectively alone have preferred this appeal by special leave, challenging their conviction and sentence.

The prosecution story entirely rests upon the direct evidence of PW Nos. 1, 2 and 3. PW-1 is none other than the son of deceased Ram Singh. He was present in his fields situated nearby the place of occurrence where his father was attacked. Jaikirat (PW-1) no doubt was doing his part time G.N.S. in

plantation at Lucknow but that itself would not make his presence doubtful at the scene of offence on the fateful day. The defence did not elicit anything in the cross-examination casting any doubt about the presence of PW-1 at the scene of offence. There is nothing unnatural about the conduct of PW-1 at the scene of occurrence. He gave detailed version as to the manner of assault and the role played by each of the accused. The names of PW-2 and PW-3 were also mentioned as eye-witnesses in the First Information Report itself. In the circumstances, PW-2 and PW-3 cannot be treated as chance witnesses. The Trial Court and as well as the High Court did not commit any error in relying on the testimony of PW-2 and PW-3 as eye-witnesses of the occurrence which fully stands corroborated with the testimony of PW-1. Be that as it may, there was not even a suggestion to PW-2 and PW-3 that they had animosity towards the accused persons. They are independent witnesses and there is no reason for them to speak against the accused.

However, it was strenuously urged that the presence of Jaikirat (PW-1) at the scene of offence is highly doubtful as he made no attempt whatsoever to save his father from being further assaulted. We find no substance in this contention. It is in the evidence of Jaikirat (PW-1) that all the four shots were fired in quick succession and at that moment PW-1 was at some distance from the actual place of attack. Be it noted that at least 2 accused were armed with fire-arms and one with lathi and they were using the weapons with all impunity. In such circumstances, Jaikirat (PW-1) may not have mustered his courage to jump into the fray and risk his own life. It is very difficult to predict or express any opinion as to what could have been normal or natural conduct of a person in such a situation. Response of individuals in such situations may differ from person to person. It is not possible to reject the evidence or doubt the presence of PW-1 on that ground.

The post-mortem examination of the deceased Ram Singh was performed by Dr. R.S. Katiyar (PW-5). The post-mortem report is exhibit Ka-4. The Medical Officer found the following ante-mortem injuries on the person of the deceased:

1. A gun shot wound (wound of entry) 3 cm x 1 cm. Over left side of face just above the left side of the lower lip. Wound of Ext. 3 cm x 2 cm. Over the right parietal bone, 7 cm. Above the right ear.
2. A gun shot wound 2.5 cm x 1 cm. Over the right side of face below max. prominence.
3. Multiple gunshot wounds in an area of 13 cm x 11 cm. Over the right side of back below the inferior angle of scapula.
4. A gun shot wound (wound of entry) 2 cm x 2 cm over the right side of the back 2 cm. Right to 12th thoracic vertebra.
5. Multiple gun shot wounds in an area of 9 cm. X 4 cm. over the back and middle of right arm.

Relying on his evidence the learned counsel for the appellant contended that the oral account as given by PW-1, 2 and 3 is at variance with medical evidence available on record. It is contended that while according to the eye-

witnesses all the four shots were fired from the gun, from right side of the victim, wound No.1 (wound of entry) was on the left side of the face and caused by bullet and this evidence belies the claim of eye witnesses that they saw the assault on Ram Singh. It is true that to a pointed query in cross-examination as regards the nature of injury no. 1, the Medical Officer stated that the said injury was caused by bullet only. The learned counsel contended that weapons in the hands of the accused even according to PW-1 were of 12 bore guns and not any pistols or revolvers. No bullet injury could have been caused with the fire-arms that were alleged to be in the hands of the assailants. We find no substance in this submission. The Medical Officer is not ballistic expert. He was not expected to answer as to whether injury No. 1 could have been caused by bullet alone. His opinion to that extent is of no consequence. It is well settled that medical evidence is only an evidence of opinion and it is not conclusive and when oral evidence is found to be inconsistent with the medical opinion, the question of relying upon one or the other would depend upon the facts and circumstances of each case. No hard and fast rule can be laid down therefor. The ocular evidence if otherwise is acceptable has to be given importance over medical opinion. However, where the medical evidence totally improbabilises the ocular version the same can be taken to be a factor to affect credibility of the prosecution version. We are not inclined to place any reliance upon the opinion of the Medical Officer that the injury no.1 could have been caused only with bullet since he is not a ballistic expert. This part of the evidence of the Medical Officer cannot be considered to be the opinion of an expert and the same has no evidentiary value. It is not possible to disbelieve the evidence of PW-1, 2 and 3 and their presence at the scene of occurrence based on the medical evidence. The High Court rightly observed that the controversy as regards injury No. 1 and whether the same could have been caused by bullet or pellet to be without any basis.

The learned counsel for the State rightly contended that in case of attack by members of unlawful assembly on the victim in furtherance of common object, it is not necessary for the prosecution to establish overtact done by each accused. It is required to be noticed that Ram Smujh (A-1) who had fired two shots, convicted by the Sessions Court, did not even challenge his conviction in the High Court. The appellants have been rightly convicted under section 302 read with aid of section 149 of IPC. PW-5 in his evidence stated that all the injuries sustained by the deceased were from gun. It is further stated that from the body of deceased one bullet, one cover tikli, two dat and 40 'chare' shots were taken out, put in packet and sealed……..'' It is also stated in his evidence that injuries caused on the body of the deceased were sufficient in the normal course to cause death. This part of the medical evidence if juxtaposed with the oral evidence of PW-1, 2 and 3 it becomes unnecessary to go into the question as to which accused caused what injury and which was a fatal one. Once a membership of an unlawful assembly is established, it is not incumbent on the prosecution to establish any specific overtact to any of the accused for fastening of liability with the aid of section 149 of the IPC. Commission of overt-act by each member of the unlawful assembly is not necessary. The common object of

the unlawful assembly of the accused in the present case is evident from the fact that some of them were armed with deadly weapons. None of them were curious onlookers or spectators to the macabre drama that was enacted on 19-2-1977 at 3.30 p.m. at galiyara, village Badipur.

For the aforesaid reasons, we find no merit in this appeal. The appeal is accordingly dismissed.

3. FORENSIC BALLISTICS EVIDENCE

3.1 Expert *v.* Non-Expert Evidence[1]

This fact came to light for the first time when the doctor was examined in the Sessions Court and the witnesses in order to corroborate their testimony with the evidence of the doctor introduced this embellishment in the story of the assault on the deceased. Considered against this background, the argument of the learned counsel for the appellants that the evidence of the eye-witnesses was inconsistent with the medical evidence appears to be well founded. In other words, the position is that if we discard this part of the evidence of the eye-witnesses which has come to light for the first time in the sessions court, then according to medical evidence, the deceased would have got two gunshots whereas it was never the prosecution case that Ram Narain Singh or any other accused fired a second shot at the deceased at any time. The medical evidence, therefore, clearly falsifies the prosecution case regarding the manner in which the deceased was hit.

The evidence of Surjit Singh and Joginder Singh of this point appears to us to be clearly an afterthought and cannot be accepted. Thus the prosecution has not been able to explain how the deceased died by sustaining gunshot injury. Furthermore, the evidence of Dr. S.S. Walia shows that there were two gunshot injuries on Teja Singh, namely, injury No. 1 which by itself was sufficient to cause his death, and injury No. 4 which was also the result of the gunshot. The doctor has further opined in his cross-examination that both injuries Nos. 2 and 4 could have been caused from a distance of less than 4 feet and that there was blackening both in injury Nos. 4 and 2 which were on the uncovered parts of the body. The doctor further deposed that there was corresponding burning of the shirt by injuries Nos. 2, 3 and 4. If this be the position, then injury No. 4 is not at all explained. The blackening on injury No. 4 clearly indicates that this was also a gunshot injury and the ballistic expert has also testified to this effect at P. 60 of the High Court paper book that in case the blackening which has been reported by the doctor in injury No. 2 and injury No. 4 were not the actual blackening due to the powder gases then it is possible that it could be from one single fire. The doctor, however, says nothing of this sort. Thus a combined reading of the evidence of Dr. Walia the medical expert and Mr. J.K. Sinha, ballistic expert, clearly establishes that the deceased died of two gunshot injuries and the prosecution has not been able to explain this important circumstance. For these reasons, therefore, the evidence of the two eye-witnesses Surjit Singh and Joginder Singh is wholly inconsistent with the medical evidence as also the evidence of ballistic expert and must be rejected on that ground alone, apart

1. *Ram Narain* v. *State of Punjab*, 1975 Cr LJ 1500.

from other inherent improbabilities which appear in their evidence and which have already been pointed out.

Where the evidence of the witnesses for the prosecution is totally inconsistent with the medical evidence or the evidence of the ballistic expert, this is a most fundamental defect in the prosecution case and unless reasonably explained, it is sufficient to discarded it the entire case. In *Mohinder Singh* v. *State*, 1950 SCR 821: AIR 1953 SC 415: 1953 Cr LJ 1761, this court observed in similar circumstances as follows:

> *"In a case where death is due to injuries or wounds caused by a lethal weapon, it has always been considered to be the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the weapon with which and in the manner in which they are alleged to have been caused. It is elementary that where the prosecution has definite or positive case, it is doubtful whether the injuries which are attributed to the appellant were caused by a gun or by a rifle."*

It is obvious that where the direct evidence is not supported by the expert evidence, then the evidence is wanting in the most material part of the prosecution case and it would be difficult to convince the accused on the basis of such evidence. While appreciating the evidence of the witnesses, the High Court does not appear to have considered this important aspect, but readily accepted the prosecution case without noticing that the evidence of the eye-witnesses in the court was belated attempt to improve their testimony and bring the same in line with the doctor's evidence with a view to support an incorrect case.

3.2 Acceptability of Arm-Ammunition Linkage[1]

While the sessions judge believed the testimony of the eyewitnesses, the learned judges of the High Court were of the opinion that they were unable to accept the assertion of the eye-witnesses that they actually saw the appellant with a pistol by the bed-side of the deceased. The High Court, however, relied upon the circumstantial evidence in the case in upholding the conviction of the appellant. There was motive for the crime and a few days before the killing of Daya Ram, the appellant had held out a threat against him. The appellant was arrested fourteen miles away from his village which is the place of occurrence. He produced a pistol (Ex. III) from his house in circumstances which clearly showed that he only could have known of its existence there.

The opinion of the firearms expert clearly established that the cartridge (Ex. I), found near the cot of Daya Ram, was fired with the pistol (Ex. III) produced by the appellant. All these circumstances, in the opinion of the High Court left no doubt that the appellant murdered Daya Ram by shooting him with his pistol.

The learned advocate for the appellant, urged that the appellant could not have placed the pistol in his house and it must have been planted there by someone because none of the witnesses stated that they had seen him going to his house after the murder and the appellant was certainly not found in

1. *Kalua* v. *State of Uttar Pradesh*, 1958 Cr LJ 300 (SC): AIR 1957 SC 180.

his house in the morning. Both the courts below, however, found no reason to disbelieve the sub-inspector, and the witnesses that the appellant had produced the pistol (Ex. III) from the corn-bin inside his house. The appellant had the key of the house which was hidden in a secret place and the corn-bin was itself freshly plastered at one place. These circumstances clearly showed that no one but the appellant could have known of the existence of the pistol in the corn-bin of the house. As to whether the appellant could or could not have gone to his house after the occurrence, that is a matter of pure speculation. It does not appear that any witness was asked anything about it. The High Court found the witness might have caught a glimpse of the people who were fast disappearing from the scene but who had no reasonable opportunity of marking their features. In the confusion of the occurrence the witnesses may not have observed where the culprit had disappeared except that they were seen running towards the east. On the record there is nothing to show that to enter the appellant's house, after the occurrence, the appellant had necessarily to go into house within the view of the witnesses. It is quite unnecessary to examine this matter any further because the evidence concerning the production of the pistol (Ex. III) by the appellant from his house is clear and reliable and, therefore, it is certain that the appellant did enter his house after the occurrence without being seen by anyone.

It was next urged on behalf of the appellant, that it was impossible for a cartridge to have been near the cot of Daya Ram, because after the shot had been fired the cartridge would still remain in the barrel of the firearm. This again is pure speculation. That the cartridge was ejected from the firearm is certain. Why it was ejected, none can say. It may be that the miscreant reloaded his weapon to meet any emergency. The evidence of the sub-inspector is clear that on his arrival at the place of occurrence the cartridge Ex. 1 was handed over to him by the witness Khamani who cannot be said to be unfavourable to the appellant. The courts below had no reason to disbelieve the evidence in the case that the cartridge Ex. I was found near the cot of Daya Ram and we can find no extraordinary circumstance to justify us saying that the courts below took an erroneous view of the evidence.

The real question is, whether it is safe to act upon the opinion of the firearms expert that the cartridge Ex. I was fired from the pistol Ex. III produced by the appellant and none other, because without that evidence the circumstantial evidence in the case would be insufficient to convict the appellant of the crime of murder. The opinion of the firearms expert, based on the result of his tests, does not seem to have been challenged in cross-examination or before the High Court. If there is no reason to think that there is any room for error in matters of this kind and it is safe to accept the opinion of the expert, then clearly it is established that the cartridge Ex. I, found near the cot of Daya Ram, was fired from the pistol Ex. III produced by the appellant. To satisfy ourselves we have looked into the works of some authors dealing with the marks left on cartridge and shell cases by firearms in order to ascertain that there is no error in the opinion of the firearms expert in the present case. Kirk in his boom *Crime Investigation* at page 346 states:—

Fired cases are less often encountered in criminal investigation than are bullets, but when found they are usually of greater significance because they receive at least as clear markings as do bullets, have a greater variety of such markings, and are not ordinarily damaged in firing.…

The questions which may be asked as a result of finding such materials are similar to those that require answers when only bullets are located. In the ordinary case, quite definite answers can be given. This is true both of shotgun shells and of cartridge cases from pistols, revolvers, and rifles....

In general, it is possible to identify a certain firearm as having fired a particular shell or cartridge, it is often possible to identify the type or make of gun which fired it, though in many instances this must be tentative or probable identification only.

After dealing with the marks left by breech-block, firing pin impressions, marks from extractors and ejectors, marks due to expansion, magazine marks and loading mechanism marks, he states:—

Summarizing, the cartridge or shell case usually carries markings which are quite distinctive of the gun in which the charge is fired, and can be used for positive identification of the latter. These marks arise from a variety of contacts with various parts of the gun, an analysis of which is useful in determining the type of weapon in case no suspected gun is available... Thus, the recovered shell or cartridge case is one of the most useful types of physical evidence which can be found in shooting cases.

Soderman and O'Connell in their book *Modern Criminal Investigation* also deal with the subject and they refer to the marks from the firing pin, the extractor, the ejector, and the breech block. After referring to comparison being made of the cartridge or shell fired from a firearm for the purpose of test, they state at page 200:—

If they are in the same position in relation to one another and their general appearance is the same, one may conclude that they have been fired from a pistol of the same make. An absolute conclusion about the origin of the shells, however, can be reached only after a photomicrographic examination of the markings from the breech block on the rear of the shell....

Identification, with the aid of the enlargement, should not prove difficult. The characteristic scratch can be easily seen. A photograph of the incriminating shell and one of a comparison shell should be pasted side by side on cardboard, and the characteristic marks should be recorded with lines and ciphers, following the same method as that used in the identification of fingerprints.

In Taylor's book on *Medical Jurisprudence*, 10th Edn., Vol. 1, at page 459, it is stated:—

It is never safe to say that a cartridge case was not fired from a given pistol unless the marks are quite different, and a case which bears no marks at all may quite well have been fired from the same pistol as one which leaves well-defined marks. In general, however, though it is unlikely that all marks will be equally good, it is usually possible to obtain definite information from the marks of the

firing pin, extractor, ejector or breech-block on the base or rim or from grooves or scratches on the surface. In weapons of the same manufacture the marks are of the same general nature, but in each weapon there are individual differences which usually enable it to be definitely identified.

The expert's evidence in this case shows that he had fired test cartridges from the pistol Ex. III. He found the individual characteristics of the chamber to have been impressed upon the test cartridge Exs. 9 and 10 and that exactly identical markings were present on the paper tube of the cartridge Ex. I. He made photomicrographs of some of these individual marks on Exs. 1 and 10. In giving his reasons for his opinion, the firearms expert stated that every firearm has individual characteristics on its breech face, striking pin and chamber. When a cartridge is fired, gases are generated by the combustion of the powder, creating a pressure of 2 to 20 tons per square inch. Under the effect of this pressure the cap and the paper tube of the cartridge cling firmly with the breech face striking, pin and chamber and being of a softer matter the individualities of these parts are impressed upon them. By firing a number of test cartridge from a given firearm and comparing them under a microscope with the evidence cartridge, it can definitely be stated, if the marks are clear, whether the evidence cartridges had been fired or not from that firearm. It seems to us that the firearm expert made the necessary tests and was careful in what he did. There is no good reason for distrusting his opinion. The learned judges of the High Court examined the photomicrographs in question and were satisfied that there was no ground for distrusting the evidence of the expert. They were accordingly justified in coming to the conclusion that the cartridge Ex. I, found near the cot of Daya Ram, was fired from the pistol Ex. III produced by the appellant from his house. There can, therefore, be no room for thinking, in the circumstances established in this case, that any one else other than the appellant might have shot Daya Ram. He was, therefore, rightly convicted for the offence of murder.

The appeal is accordingly dismissed.

3.3 Ballistics Evidence Essential/not Essential[1]

The genesis of the prosecution case, in brief, was that on 13.10.1993 at about 11.50 a.m., one Sri Krishna Sharma (P.W.1), husband of the deceased, lodged an F.I.R. with the police station Majhola, District Moradabad to the effect that on that day, at about 9.45 a.m., when he alongwith his wife and children was watching television, the appellant who was living opposite their house and was a cable operator along with his servant Dharamveer, came to their house and tried to persuade his son-Ravindra Sharma (P.W.2) to take a cable connection from them. Not being interested in the cable connection, they declined the request of the appellant whereupon an altercation took place between the appellant and P.W.2. The complainant and his wife intervened and asked the appellant to leave their house. The appellant went to his house, brought out the licensed revolver of his father and opened indiscriminate firing towards complainants house from the door of his house. Some bullets hit the door of the house of Sri Krishna Sharma and while his wife, the victim, was closing the door, one of the

1. *Vineet Kumar Chauhan* v. *State of Uttar Pradesh,* 2008 Cr LJ 1367.

bullets hit her in the jaw. Sri Krishna Sharma brought his injured wife to the hospital for treatment and thereafter lodged the F.I.R.

3. The victim was examined by Dr. Jagmal Singh, P.W.4. The following injuries were found on her person:

1. Lacerated wound 1.5 cm. x .5 cm x not probed on face, left side over left mandible, 3 cm. below and outer to left angle of mouth. Advised x-ray of left side fact and left side neck.
2. Lacerated wound .5 cm x .5 cm x skin on left arm outer part, 4 cm. above left elbow.

4. Both the injuries were found to be fresh. Injury No.1 was alleged to have been caused by firearm but final opinion was reserved to be given after the x-ray. Injury No. 2 was caused by a blunt object. On x-ray being taken, a radio opaque shadow elongated was found in thoracic spine in dorsal region over T 5-6.

5. The victim remained under treatment and supervision of Dr. D.S. Ahlawat (P.W.5). On 15.10.1993, she was taken to Delhi for treatment. However, on 21.10.1993, she was again admitted in Moradabad Hospital, where she developed bedsores. Smt. Premwati ultimately died on 25.3.1994. As per the autopsy conducted by Dr. S.P. Singh (P.W.7) on 25.3.1994, the ante-mortem injuries were mainly deep bedsores on various parts of the body and one old healed scar, size 1.2 cm x .5 cut, on the left face at the chin 2.5 cm. away from medium plank thoracic spine. On internal examination, the doctor recovered a metallic bullet from her spinal cord, which had caused extensive damage in thoracic spine and paralysis in half of the body. The cause of death was opined to be septicemia and toxemia due to bedsores. After investigations, charge sheet under sections 452 and 307 was filed against the appellant and his father. However, charges were framed against them under sections 302 and 307 IPC.

8. Mr. Sushil Kumar, learned senior counsel appearing on behalf of the appellant assailed the conviction of the appellant mainly on the ground that apart from the fact that the Ballistic Report casts a serious doubt that the distorted bullet allegedly recovered from the spot came out of the seized revolver, it was also obligatory on the part of the prosecution to send the bullet, allegedly recovered from the body of the deceased, for being examined by the Ballistic Expert, so as to connect the recovered licensed revolver of the appellants father with the crime. It was submitted that since it was a positive case of the prosecution that the bullet which had hit the deceased was fired from the seized revolver, omission to send the bullet for ballistic examination is a serious infirmity in the prosecution case, which assumes still greater significance because of Ballistic Report, which does not even establish that the remnants of the bullet (lead), recovered from the place of incident, was of the bullet fired from the revolver allegedly used by the appellant. In support, strong reliance is placed on the decision of this Court in *Mohinder Singh* v. *The State*, wherein it was observed that in a case where death is due to injuries or wounds caused by a lethal weapon, it has always been considered to be the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have

been caused with the weapon with which and in the manner in which they are alleged to have been caused. Reference is also made to another decision of this Court in *State of Madhya Pradesh* v. *Surpa*, expressing a similar view. Learned counsel has also contended that all through the case of the prosecution was that the accused was firing towards the house of the deceased without aiming at any person and the bullet hit the deceased accidentally when she was closing the door of the house. It is urged that in case the appellant had any intention to commit the murder of the deceased or any member of her family, he would have gone to their house and shot them. It is argued that even if the occurrence is admitted to have taken place in the manner alleged, the appellant cannot be held guilty for the commission of offence punishable under section 302 IPC. It is asserted that the occurrence having taken place without pre-meditation, in the heat of the passion upon a sudden quarrel, the appellant is entitled to the benefit of Exception 4 of section 300 IPC.

9. Learned counsel for the State, on the other hand, supported the view taken by the High Court.

10. It cannot be laid down as a general proposition that in every case where a firearm is allegedly used by an accused person, the prosecution must lead the evidence of a Ballistic Expert to prove the charge, irrespective of the quality of the direct evidence available on record. It needs little emphasis that where direct evidence is of such an unimpeachable character, and the nature of injuries, disclosed by post-mortem notes is consistent with the direct evidence, the examination of Ballistic Expert may not be regarded as essential. However, where direct evidence is not available or that there is some doubt as to whether the injuries could or could not have been caused by a particular weapon, examination of an expert would be desirable to cure an apparent inconsistency or for the purpose of corroboration of oral evidence. (See: Gurcharan Singh v. State of Punjab)

11. In Mohinder Singhs case (supra) on which strong reliance is placed on behalf of the appellant, this Court has held that, where the prosecution case was that the accused shot the deceased with a gun, but it appeared likely that the injuries on the deceased were inflicted by a rifle and there was no evidence of a duly qualified expert to prove that the injuries were caused by a gun, and the nature of the injuries was also such that the shots must have been fired by more than one person and not by one person only, and the prosecution had no evidence to show that another person also shot, and the oral evidence was of witnesses who were not disinterested, the failure to examine an expert would be a serious infirmity in the prosecution case. It is plain that these observations were made in a case where the prosecution evidence was suffering from serious infirmities. Thus, in determining the effect of these observations, the facts in respect of which these observations came to be made cannot be lost sight of. The said case therefore, cannot be held to lay down an inflexible rule that in every case where an accused person is charged with murder caused by a lethal weapon, the prosecution case can succeed in proving the charge only if Ballistic Expert is examined. In what cases, the examination of a Ballistic Expert is

essential for the proof of the prosecution case, must depend upon the facts and circumstances of each case.

12. In the instant case, having regard to the ocular evidence adduced by the prosecution, there is no reason to discard the prosecution theory that the injury as a result whereof Smt. Premwati suffered complete paralysis of both the lower limbs etc. was caused by a bullet fired from a revolver. The nature of the injury as proved by Dr. P.S. Ahlawat (P.W.5), under whose treatment the deceased remained at Moradabad and Dr. S.P. Singh (P.W.7), who had conducted the post-mortem examination is wholly consistent with the prosecution version. It is clear that the bullet recovered by P.W.7 at the time of post-mortem of the victim had traversed to thoracic spine through the neck from the face near the angle of the jaw, hitting the fifth thoracic vertebra, badly damaging the underlying spinal cord. We are therefore, of the view that on the facts of the present case, the absence of Ballistic Experts evidence is not fatal to the case of the prosecution, notwithstanding the fact that the Forensic Science Laboratory, in its report dated 18.2.1991, had not expressed a definite opinion about the bullet recovered from the place of occurrence.

13. Insofar as the testimonies of P.W.1 and P.W.2, the two star witnesses of the prosecution, are concerned, from the impugned judgment, it is manifest that the High Court, on analysis of their statements, has found these to be trustworthy. The High Court has observed that testimony of these two natural witnesses is of sterling character with no holes whatsoever. Based on this evidence, the High Court has found that it was the appellant who had opened fire from the revolver from his door, one of which had hit the victim, who had come to close the main door of her house. Nothing has been shown to us so as to warrant interference with the said finding recorded by the High Court. Therefore, in the context of this unimpeachable evidence, it stands proved that the appellant had gone to the house of the deceased; some unsavoury incident took place there; he returned to his house in a huff; took out the revolver of his father and fired shots towards the house of the deceased; one of the bullets hit the deceased and the same proved to be fatal. Having bestowed our anxious consideration to the evidence on record, in particular the testimony of P.W.1 and P.W. 2, we are of the opinion that the High Court was correct in coming to the conclusion that the appellant was responsible for causing the fatal injury to the deceased. We are also in agreement with the High Court that though as per the post-mortem report the deceased died of septicemia and toxemia because of bedsores, the basic cause of her death was the bullet injury caused to her by the appellant.

3.4 Ballistic Evidence Essential[1]

To justify the opinion of the High Court, learned counsel for the respondents-accused argued that as the doctor had not made a mention of gun shot injuries in the post-mortem report, his later deposition before the police regarding the nature of the injuries should not be accepted. We cannot accept such a plea either legally or factually. There is no obligation on the doctor to describe the origin or cause of the injuries in the post-mortem report as he stated in his deposition in

1. *State of Punjab* v. *Jugraj Singh*, 2000 Cr LJ 1503 (SC).

the Court. Otherwise also we find that a mention of fire-arm injury is factually made in one of the columns of the post-mortem report. It is further contended that as the doctor had stated that "due to putrefaction the normal anomy of tissues is disturbed, so collar of abrasion showing two zones of inner grease and outer of abrasions was not possible for me to distinguish", the medical report could not be relied upon. In support of his contention, the learned counsel has referred to *Modi's Medical Jurisprudence and Toxicology*—Twenty-second Edition where it is stated that putrefaction follows the disappearance of the *rigor mortis*, and that as the *rigor mortis* was present, putrefaction could not have been noticed by the doctor. We have perused the opinion of the learned Author and find that in the same heading "Putrefaction of Decomposition and Autolysis" it is stated that "putrefaction follows the disappearance of the *rigor mortis*, but this is not always the case; since, in Northern India, especially during the hot months from April to October, it commences before *rigor mortis* has completely passed off from the lower extremities." It is not disputed that the occurrence had taken place in Northern India during the period, referred to by the learned Author.

Pointing out to another defect of not sending the weapon of offence, the guns, to the Ballistic Expert for examination for his expert opinion, it is argued that the creditworthiness of the case is totally demolished entitling the respondents the benefit of acquittal. In support of his contention, the learned counsel relied upon a judgment of this court in *Sukhwant Singh* v. *State of Punjab*, 1995 (3) SCC 367 wherein it is held that:

> *"There is yet another infirmity in this case. We find that whereas an empty had been recovered by P.W. 6, ASI Raghubir Singh from the spot and a pistol along with some cartridges were seized from the possession of the appellant at the time of his arrest, yet the prosecution, for reasons best known to it, did not send the recovered empty and seized pistol to the Ballistic Expert for examination and expert opinion. Comparison could have provided link evidence between the crime and the accused. This again is an omission on the part of the prosecution for which no explanation has been furnished either in the trial court or before us. It hardly needs to be emphasised that in cases where injuries are caused by fire-arms, the opinion of the Ballistic Expert is of a considerable importance where both the fire-arm and the crime cartridge are recovered during the investigation to connect an accused with the crime. Failure to produce the expert opinion before the trial court in such cases affects the creditworthiness of the prosecution case to a great extent."*

In that case the evidence of the two eye-witnesses was held inadmissible as they were not examined in terms of section 138 of the Evidence Act and the court did not rely upon the sole testimony of Gurmej Singh (P.W. 3). In that context the court observed that failure to produce the expert opinion affected the creditworthiness of the prosecution case to a great extent. Nowhere it was held that on account of failure to produce the expert opinion the prosecution version in all cases should be disbelieved.

In the instant case the Investigating Officer has categorically stated that guns seized were not in a working condition and he, in his discretion, found that no purpose would be served for sending the same to the Ballistic Expert for

his opinion. No further question was put to the Investigating Officer in cross-examination to find out whether despite the guns being defective the fire print was in order or not. In the presence of convincing evidence of two eye-witnesses and other attending circumstances we do not find that the non-examination of the expert in this case has, in any away, affected the creditworthiness of the version put forth by the eye witnesses.

3.5 Expert Evidence Essential[1]

According to the prosecution case, the appellant is married to the sister of Pal Singh. An engagement had been brought about through the instrumentality of the appellant between the daughter of Pal Singh and Lakhmir Singh son of Kashmir Singh. The deceased, Ajmer Singh and his brother, Gurmej Singh PW3 were on friendly terms with Kashmir Singh but for some reason or the other, that engagement was snapped and Lakhmir Singh was married to some other girl about 3 days prior to the occurrence. The appellant suspected that Ajmer Singh deceased and his brother Gurmej Singh PW were responsible for the snapping of the engagement. On 11-7-1984 at about 7.30 p.m., Gurmej Singh PW3 accompanied by Ajmer Singh, deceased and Raghbir Singh, PW4 were going to the fields to answer the call of nature and when they reached near the bridge on the village pond, the appellant came from the opposite side wearing the robes of a Nihang and exhorted that he would teach them a lesson for getting the engagement snapped. Immediately, thereafter the appellant took out a pistol from underneath the chola (robes) that he was wearing and fired a shot at Ajmer Singh. On alarm being raised by Ajmer Singh, PW3 and PW4, the appellant fled away along with the pistol. One Major Singh, PW5 who was also present in the nearby field also witnessed the occurrence. Ajmer Singh was removed to the haveli and while he was being shifted to the Hospital at Malout, in the tractor trolley of Kashmir Singh, he expired. On reaching the hospital, the doctor pronounced Ajmer Singh dead. On information being sent by Dr. Sang Singh, Ex.PS about the arrival of Ajmer Singh deceased at the hospital to the police station, Shri Raghubir Singh, ASI PW6 proceeded to the hospital and recorded the statement of Gurmej Singh, Ex. P-4 at about 11.45 p.m. The statement was sent to the police station for registration of a case and on its basis formal FIR Ex.P.4/8 was drawn up. A case under section 302, IPC and section 25, Arms Act was registered at 12.10 a.m. on 12-7-1984. A copy of the special report was sent to the Ilaqa Magistrate and was received by him on 12-7-1984 at about 6.30 a.m. After preparing the inquest report Ex. P.2, the dead body was despatched for post-mortem which was performed by Dr. Sant Parkash Singh, Sr. Medical Officer PW1 on July 12, 1984 at about 11 a.m. The doctor found fire-arm injuries on the deceased and opined that the death had been caused due to shock and hemorrhage as a result of injury No. 1, which was found to be sufficient in the ordinary course of nature to cause death. During the investigation by ASI Raghubir Singh, PW6 the rough site plan of the place of occurrence was prepared. From the spot, blood stained earth as well as an empty were collected *vide* memo Ex. P.8. The same were secured in separate

1. *Khushwant Singh* v. *State of Punjab,* AIR 1995 SC 1601.

sealed parcels. The appellant was arrested on 8-8-1984 and at the time of his arrest, he was found to be carrying with him a pistol and 7 live cartridges which were seized by the police.

At the trial, the prosecution examined Dr. Sant Parkash Singh, PW1, draughts man Ajit Sharma, PW2, Gurmej Singh, PW3 and Raghubir Singh, ASI PW6. Raghbir Singh PW4 and Major Singh PW5, the two other eye-witnesses were tendered for cross-examination only. The appellant denied the prosecution allegations against him in his statement under section 313, Cr. P.C. The appellant was, therefore, convicted and sentenced for the offence under section 302, IPC. The case under section 25, Arms Act was separately tried.

Learned counsel for the appellant submitted that the solitary eye-witness examined at the trial by the prosecution Gurmej Singh, PW3 could not be relied upon, as not only he being the brother of the deceased was interested in the prosecution case but also because his evidence stood belied by the medical evidence which showed that the stomach and the bladder of the deceased were empty thereby suggesting that the injuries had been received by the deceased after he had answered the call of nature and not before as suggested by Gurmej Singh PW3 . Learned counsel also submitted that in Rukka Ex.PS which was sent by the doctor to the police station, it was recorded that the dead body had been brought to the hospital by Raghbir Singh and Major Singh and the name of Gurmej Singh was conspicuous by its absence which went to show that Gurmej Singh PW3 was not present at the time of occurrence or when the deceased was removed to the hospital. According to the learned counsel, the non-examination of Raghbir Singh, PW4 and Major Singh, PW5 by the prosecution, who were only tendered for cross-examination, is a serious infirmity in the prosecution case and renders it unsafe to uphold the conviction of the appellant on the basis of the uncorroborated testimony of Gurmej Singh, PW3.

Gurmej Singh, PW3, is the elder brother of the deceased. He is the solitary eye-witness examined by the prosecution. The absence of his name from rukka Ex. P-5, sent by the doctor to the police station immediately after the arrival of the dead body in the hospital creates some doubt about the presence of Gurmej Singh at the place of occurrence at the time when the deceased was shot at. In the normal course of human conduct the real brother of the deceased would have accompanied the injured to the hospital. The identification of the deceased by Gurmej Singh and Major Singh PWs at the time of post-mortem examination of the deceased, which has been relied upon by learned counsel for the State, cannot cure the defect of the absence of the name of PW3 from Ruqqa Ex. P.5 because the post-mortem examination was conducted the next day on 12-7-1984 at 11.00 a.m. There is no explanation available on the record, nor has any been offered before us to explain the absence of the name of PW3 from Ruqqa Ex. P.5 in which it was recorded that Raghbir Singh and Major Singh had brought the deceased to the hospital.

That the deceased died as a result of fire-arm injuries is not disputed but what has been challenged is whether the occurrence took place in the manner described by Gurmej Singh PW3 and whether Gurmej Singh PW3 is an eye-witness. The first information report was recorded by Raghubir Singh PW6 on

the basis of the statement of Gurmej Sigh, Ex.P-4 which was recorded at the hospital at about 11.45 p.m. on 11-7-1984. The possibility that Gurmej Singh PW3 might have arrived at the hospital later on after learning about the removal of his deceased brother to the hospital by Raghibir Singh and Major Singh cannot be ruled out. Moreover, we find that the special report reached the Ilaqa Magistrate on the next day at 6.30 a.m. There is no explanation available on the record about the delay in the report of the special report by the Ilaqa Magistrate. When admittedly the Court of the Ilaqa Magistrate and the police station are quite close to each other. The fact that at the time of post-mortem examination the stomach and the bladder were found empty, though suggestive of the position that contrary to what Gurmej Singh, PW3 deposed, the deceased had answered the call of nature before he was shot at, but cannot be conclusive of it, as the possibility that the deceased might have defalcated and urinated after the receipt of injuries and before his death cannot be ruled out.

The prosecution in this case came up with a positive case that besides Gurmej Singh, PW3, Raghbir Singh PW4 and Major Singh PW5 had also witnessed the occurrence. The names of these two witnesses are also mentioned in the rukka Ex.P.5 as the persons who had brought the dead body to the hospital. Their evidence in the circumstance of the case was essential for unfolding of the prosecution case. The prosecution however did not examine them and tendered them for cross-examination by the accused at the trial but they were not cross-examined by the accused. From the record of the trial Court we find that both PW4 and PWS had been tendered for cross-examination "in the light of the observations of the Supreme Court in the case of *Jaggo*, AIR 1971 SC 1586". We are at a loss to appreciate how a witness could be cross-examined, when he has not been examined-in-chief that is to say, when there is nothing in relation to which he could be cross-examined.

In *State of Uttar Pradesh* v. *Jaggo* alias *Jagdish*, AIR 1971 SC 1586, which has been referred to and relied upon by the prosecution and the trial Court for adopting the procedure of tendering PW 4 and PW 5 for cross-examination only in our opinion, has not been properly appreciated and has been misapplied. That judgment cannot be read to lay down, as a matter of legal proposition, that a witness can be "tendered" for cross-examination even without there being any examination-in-chief. If there is some earlier statement of the witness recorded by a competent Court or an affidavit filed in the trial Court and the witness testifies to the correctness of that earlier statement at the trial, it may (in certain cases of witnesses of formal nature) as noticed earlier be permissible to tender him for cross-examination after he is sworn to the correctness of the earlier statement, because in that event that earlier statement is treated as the examination-in-chief of the witness but that is not the same thing as tendering a witness for cross-examination only, without there being, any examination-in-chief on the record. In *Jaggo's* case, AIR 1971 SC 1586 (*supra*), Bench of this Court was considering the question whether the mere presentation of an application by the prosecution to the effect that a certain witness had been "won over" was conclusive of the allegation that he had been so "won over" and the prosecution was therefore relieved of its obligation to examine him at the trial. The proposition was

negatived and it was in that context, that this Court observed (at p. 1590, para 16):—

> *"On behalf of the appellant it was said that Ramesh Chand was won over and therefore the prosecution could not call Ramesh. The High Court rightly said that the mere presentation of an application to the effect that a witness had been won over was not conclusive of the question that the witness has been won over. In such a case Ramesh could have been produced for cross-examination by the accused. That would have elicited the correct facts. If Ramesh were an eye-witness the accused were entitled to test his evidence particularly when Lalu was alleged to be talking with Ramesh at the time of the occurrence. (Emphasis ours)."*

The Division Bench, therefore, was considering a peculiar fact situation in that case and even in that context it was observed that the witness "could have been produced for cross-examination by the accused" and that "the accused were entitled to test his evidence". The observation of the Division Bench in *Jaggo's* case, therefore, do not support the view that a material witness can be "tendered" for cross-examination only. The observation from a judgment of this Court cannot be read in isolation and divorced from the context in which the same were made and it is improper for any Court to take out a sentence from the judgment of this Court, divorced from the context in which it was given, and treat such an isolated sentence as the complete enunciation of law by this Court. The judgment in *Jaggo's* case, AIR 1971 SC 1586 (*supra*), has in our opinion been misappreciated and that judgment cannot be interpreted as a sanction from the Supreme Court to the prosecution to adopt the practice of tendering a witness for cross-examination only, without there being any examination-in-chief, in relation to which the witness has to be cross-examined. All that the judgment in *Jaggo's* case (supra) is emphasised is that the mere *ipse dixit* of the prosecutor that a particular witnesses has been won over is not conclusive of that allegation and the Court should not accept the same mechanically and relieve the prosecutor of his obligation to examine such a witness. It was for this reason suggested by the Bench that where the prosecution makes such an allegation, it must keep the witness in attendance and produce him to enable the defence to cross-examine such a witness to test his evidence as well as the allegations of the prosecution and bring out the truth on the record. After the coming into force of the Criminal Procedure Code, 1973, which replaced the Code of 1898, recording of evidence in commitment proceedings have been totally dispensed with and section 288 of that Code has been omitted. Consequently, the course suggested by some of the High Courts in the earlier quoted judgments regarding tendering of a witness for cross-examination who had been examined in the committal Court, is also no more relevant or available. The *Jaggo's* case, which was decided when the Code of 1898 was operating in the field could not, therefore, be pressed into service by the trial Court while dealing with the instant case tried according to the Code of 1973. Thus, considered it is obvious that the trial Court wrongly permitted the prosecution to tender PW 4 and PW 5 for cross-examination only. Both PW4 and PW5 were, according to the prosecution case itself, eye-witnesses of the occurrence and had removed the deceased to the hospital. Their evidence was, of a material nature which was necessary for the unfolding of the prosecution story.

The effect of their being tendered only for cross-examination amounts to the failure of the prosecution to examine them at the trial. Their non-examination, in our opinion, seriously affects the credibility of the prosecution case and detracts materially from its reliability.

There is yet another infirmity in this case. We find that whereas an empty had been recovered by PW6, ASI Raghubir Singh from the spot and a pistol along with some cartridges were seized from the possession of the appellant at the time of his arrest, yet the prosecution, for reasons best known to it, did not send the recovered empty and the seized pistol to the ballistic expert for examination and expert opinion. Comparison could have provided link evidence between the crime and the accused. This again is an omission on the part of the prosecution for which no explanation has been furnished either in the trial Court or before us. It hardly needs to be emphasised that in cases where injuries are caused by firearms, the opinion of the Ballistic Expert is of a considerable importance where both the fire-arm and the crime cartridge are recovered during the investigation to connect an accused with the crime. Failure to produce the expert opinion before the trial Court in such cases affects the creditworthiness of the prosecution case to a great extent.

From a critical analysis of the materials on the record, we find that it would not be safe to rely upon the sole testimony of PW3 Gurmej Singh, the brother of the deceased, without independent corroboration in view of the infirmities pointed out by us above which render his testimony as not wholly reliable and since in the present case no such independent corroboration is available on the record, it would be unsafe to rely upon the testimony of PW 3 only to uphold the conviction of the appellant. The prosecution has not been able to establish the case against the appellant beyond a reasonable doubt. The trial Court, therefore, fell in error in convicting and sentencing the appellant. His conviction and sentence cannot be sustained. This appeal consequently succeeds and is allowed. The conviction and sentence of the appellant is set aside. The appellant is on bail. His bail bonds shall stand discharged.

3.6 Expert evidence not Essential[1]

1. Whilst we are on this point, we may briefly indicate the nature of the prosecution case so far as the use of the guns is concerned. The appellant Gurcharan Singh had fired two shots, one of which killed Sukhjit Singh and the other Gurdial Singh. The appellant Surjit Singh had fired three shots, two at Arjan Singh and one at Piara. The evidence seems to show that Surjit Singh loaded the gun once in the presence of the witnesses and whilst so doing, he put two cartridges in the gun and the spent cartridges in his pocket. The two empties which had been sent for expert examination were found and picked up on a thoroughfare in front of the house of Jarnail Singh. Apparently, the prosecution case is that these two cartridges had been fired by the appellant Gurcharan Singh from Arjan Singh's gun picked up by him. In any event, the report shows that the two cartridges had been fired from the same gun. That

1. *Gurucharan Singh* v. *State of Punjab,* 1963 (1) Cr LJ 323 (SC): AIR 1963 SC 340.

is why the failure to prove the report cannot be said to have prejudiced the appellant's case at all.

Mr. Purushotam, however, argued that a ballistic expert should have been examined in order to ascertain whether the gun surrendered by Daljit Singh had been used at all. But this argument is obviously untenable for the simple reason that this gun was surrendered more than a week after the incident and it takes no imagination to realize that when Daljit Singh surrendered the gun, he must have cleaned it so as to remove any evidence about its use on the date of the incident.

It has, however, been argued that in every case where an accused person is charged with having committed the offence of murder by a lethal weapon, it is the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the weapon with which, and in the manner in which they have been alleged to have been caused; and in support of this proposition, reliance has been placed on the decisions of this court in *Mohinder Singh* v. *The State*, 1950 SCR 821: AIR 1953 SC 415. In that case, this court has held that where the prosecution case was that the accused shot the deceased with a gun, but it appeared likely that the injuries on the deceased were inflicted by a rifle and there was no evidence of a duly qualified expert to prove that the injuries were caused by a gun, and the nature of the injuries was also such that the shots must have been fired by more than one person and not by one person only, and there was no evidence to show that another person also shot and the oral evidence was such which was not disinterested, the failure to examine an expert would be a serious infirmity in the prosecution case. It would be noticed that these observations were made in a case where the prosecution evidence suffered from serious infirmities and in determining the effect of these observations, it would not be fair or reasonable to forget the facts in respect of which they came to be made. These observations do not purport to lay down an inflexible rule that in every case where an accused person is charged with murder caused by a lethal weapon, the prosecution can succeed in proving the charge only if an expert is examined. It is possible to imagine cases where the direct evidence is of such an unimpeachable character and the nature of the injuries disclosed by post-mortem notes is so clearly consistent with the direct evidence that the examination of a ballistic expert may not be regarded as essential. Where the direct evidence is not satisfactory or disinterested or where the injuries are alleged to have been caused with a gun and they *prima facie* appear to have been inflicted by a rifle, undoubtedly the apparent inconsistency can be cured on the oral evidence of a ballistic expert. In what cases the examination of a ballistic expert is essential for the proof of the prosecution case, must naturally depend upon the circumstances of each case. Therefore, we do not think that Mr. Purushotam is right in contending as a general proposition that in every case where a firearm is alleged to have been used by an accused person, in addition to the direct evidence, prosecution must lead the evidence of a ballistic expert, however, good the direct evidence may be and though on the record there may be no reason to doubt the said direct evidence.

In the present case, no useful purpose could have been served by examining an expert for the purpose of showing that the gun had been used by Surjit Singh,

because, as we have already pointed out, Daljit Singh took care to keep the gun with himself for over a week and then surrendered it. It would be idle in such a case to suggest that it was necessary for the prosecution to examine an expert even though it is extremely unlikely that traces of its use had not been removed by Daljit Singh before he surrendered it. Then, as to Gurucharan Singh, it is admitted that he fired twice and there is nothing on the record to show that the injuries disclosed by the postmortem notes and deposed to by the doctor could not have been caused by a gun which, it was alleged, belonged to Arjan Singh and which was picked up by Gurucharan Singh after it fell down from his hands. Therefore, in the circumstances of this case, we do not think it would be possible to accept the plea that the failure of the prosecution to examine a ballistic expert has introduced a serious infirmity in the prosecution case.

For simultaneous trial for offences both under IPC and Arms Act not permissible, see, *Surendra Singh Rautela* v. *State of Bihar*, AIR 2002 SC 260.

3.7 Ballistics Expert Evidence Essential[1]

The last argument which Mr. Anthony has urged before us is that the prosecution should have examined a ballistic expert in this case and since no expert has been examined, it cannot be said that the prosecution has proved its case that the appellants caused the deaths of the two victims by shooting from the rifles which they carried. In support of this argument, Mr. Anthony has referred us to the decision of this court in *Mohinder Singh* v. *The State*, AIR 1953 SC 415. In that case, it has been observed by this court that it has always been considered to be the duty of the prosecution, in a case where death is due to injuries or wounds caused by a lethal weapon, to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the weapon with which and in the manner in which they are alleged to have been caused. We do not see how this principle can be invoked by Mr. Anthony in the present case. The rifles which the appellants are alleged to have used have not been recovered and so, there was no occasion to examine any expert in respect of the injuries caused to the two victims by the appellants. What Mr. Anthony suggested is that an expert should have been examined for the purpose of determining whether any of the injuries found on the persons of the several victims could have been inflicted by the revolver which had been recovered in this case.

Now, the story about the recovery of this revolver is very interesting. According to the defence, Amin Lal was carrying a revolver and when he was hit with a lathi by Sajjan Singh, the revolver fell down from his hands and Yudhbir Singh picked it up and fired it at Amin Lal. Now this revolver was carried away by Yudhbir Singh to his house and said that he produced the same before the police investing officer. On the other hand, according to Gurbux Singh, it was the accused Sajjan Singh who after his arrest produced the pistol and two live cartridges before him. It would thus appear that the revolver had been produced by one of the accused persons on the allegation that it was carried by Amin Lal and had been used by Yudhbir Singh in self-defence after it had fallen

1. *Jaidev and Hari Singh* v. *State of Punjab,* 1963 (1) Cr LJ 495 (SC): AIR 1963 SC 612.

down from Amin Lal's hands. It has not been the prosecution case that it is this revolver which had been used by Yudhbir Singh. It may well be that the revolver has been deliberately surrendered by the accused in order to introduce complications in the case. We think, in such a case it is difficult to understand for what purpose the prosecution was expected to examine the expert. Therefore, in our opinion, the decision in the case of Mohinder Singh, AIR 1953 SC 415 has no application to the case before us.

3.8 Evidence of Surrender not plausible[1]

Appellant Dayanand is said to have surrendered before the Station House Officer on the 15th November, 1969 and is also said to have produced a country-made pistol. The High Court has not rightly relied upon the story of production of the pistol by appellant Dayanand.

It is a peculiar characteristic of several cases in the States of Punjab and Haryana that the accused is found ready to surrender the weapons allegedly used in the occurrence.

Be that as it may, although the pistol was sent to the Ballistics Expert, it could not be examined and proved by him that the pistol said to have been produced by the appellant Dayanand was the one from which a shot had been fired at Amar Singh. It may be stated here that a bullet on autopsy was recovered from the body of Amar Singh and another bullet was extracted from the buttock of Balbir Singh. The two bullets were also sent to the Ballistics Expert. The pistol and the bullets remained lying for a considerable time at his end but he did not find time to examine them. It appears from the records of the trial court that the Ballistics Expert wanted some more time to examine the materials and give his opinion. But since the High Court was in a hurry to close the case, the Public Prosecutor decided to give up the examination and obtaining of opinion of the Ballistics Expert.

None of the appellants had a licensed pistol. In all probability, therefore, they had used country-made pistols. In such a situation it is difficult to assume that Ballistic Expert could have found identifying marks on the bullets[2] and his opinion would have gone against the prosecution. We do not think that the prosecution had any design or motive in not obtaining the opinion of the expert.

3.9 Absence of Ballistics Expert Evidence: not always Fatal[3]

The genesis of the prosecution case, in brief, was that on 13-10-1993 at about 11.50. a.m., one Sri Krishna Sharma (P.W.1), husband of the deceased, lodged an F.I.R. with the Police Station Majhola, District Moradabad to the effect that on that day, at about 9.45 a.m., when the along with his wife and children was watching television, the appellant who was living opposite their house and was a cable operator along with his servant Dharamveer, came to their house and tried

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1. *Chatar Singh* v. *State of Haryana,* 1976 Cr LJ 1891: AIR 1976 SC 2474.
2. The country-made (improvised) firearms more often than not, provide identifiable marks on the fired projectiles! **(Author's Note).**
3. *Vineet Kumar Chauhan* v. *State of Uttar Pradesh,* 2008 Cr LJ 1367 (SC).

to persuade his son-Ravindra Sharma (P.W.2) to take a cable connection from them. Not being interested in the cable connection, they declined the request of the appellant whereupon an altercation took place between the appellant and P.W. 2. The complainant and his wife intervened and asked the appellant to leave their house. The appellant went to his house, brought out the licensed revolver of his father and opened indiscriminate firing towards complainant's house from the door of his house. Some bullets hit the door of the house of Sri Krishna Sharma and while his wife, the victim, was closing the door, one of the bullets hit her in the jaw. Sri Krishna Sharma brought his injured wife to the hospital for treatment and thereafter lodged the F.I.R.

The victim was examined by Dr. Jagmal Singh, P.W.4. The following injuries were found on her person:

1. Lacerated wound 1.5 cm. x .5 cm x not probed on face, left side over left mandible, 3 cm. below and outer to left angle of mouth. Advised X-ray of left side face and left side neck.
2. Lacerated wound .5 cm x .5 cm x skin on left arm outer part, 4 cm. above left elbow.

Both the injuries were found to be fresh. Injury No. 1 was alleged to have been caused by firearm but final opinion was reserved to be given after the X-ray. Injury No. 2 was caused by a blunt object. On X-ray being taken, a radio opaque shadow elongated was found in thoracic spine in dorsal region over T 5-6.

The victim remained under treatment and supervision of Dr. D.S. Ahlawat (P.W.5). On 15-10-1993, she was taken to Delhi for treatment. However, on 21-10-1993, she was again admitted in Moradabad Hospital, where she developed bedsores. Smt. Premwati ultimately died on 25-3-1994. As per the autopsy conducted by Dr. S.P. Singh (P.W.7) on 25-3-1994, the ante-mortem injuries were mainly deep bedsores on various parts of the body and one old healed scar, size 1.2 cm x .5 cut, on the left face at the chin 2.5 cm. away from medium plank thoracic spine. On internal examination, the doctor recovered a metallic bullet from her spinal cord.

Insofar as the testimonies of P.W. 1 and P.W. 2, the two star witnesses of the prosecution, are concerned, from the impugned judgment, it is manifest that the High Court, on analysis of their statements, has found these to be trustworthy. The High Court has observed that testimony of these two natural witnesses is of sterling character with no holes whatsoever. Based on this evidence, the High Court has found that it was the appellant who had opened fire from the revolver from his door, one of which had hit the victim, who had come to close the main door of her house. Nothing has been shown to us so as to warrant interference with the said finding recorded by the High Court. Therefore, in the context of this unimpeachable evidence, it stands proved that the appellant had gone to the house of the deceased; some unsavoury incident took place there; he returned to his house in a huff; took out the revolver of his father and fired shots towards the house of the deceased; one of the bullets hit the deceased and the same proved to be fatal. Having Bestowed our anxious consideration

to the evidence on record, in particular the testimony of P.W. 1 and P.W. 2, we are of the opinion that the High Court was correct in coming to the conclusion that the appellant was responsible for causing the fatal injury to the deceased. We are also in agreement with the High Court that though as per the post-mortem report the deceased died of septicemia and toxemia because of bedsores.

Reverting to the facts in hand, as noted above, it stands proved that there being a direct causal connection between the hitting of the bullet, fired by the appellant, to the deceased and her death, the death of the deceased' was caused by the appellant. However, having regard to the circumstances, briefly enumerated above, particularly the manner in which the appellant fired the shots, in our view, the appellant could not be attributed the *mens rea* requisite for bringing the case under clause (3) of section 300, IPC. Concededly, there was no enmity between the parties and there is no allegation of the prosecution that before the occurrence, the appellant had premeditated the crime of murder. We are inclined to think that having faced some sort of hostile attitude from the family of the deceased over the cable connection, a sudden quarrel took place between the appellant and the son of the deceased, on account of heat of passion, the appellant went home; took out his father's revolver and started firing indiscriminately, and unfortunately one of the bullets hit the deceased on her chin. At the most, it can be said that he had the knowledge that the use of revolver was likely to cause death and, as such, the present case would fall within the third clause of section 299, IPC. Thus, in our opinion, the offence committed by the appellant was only "culpable homicide not amounting to murder". Under these circumstances, we are inclined to bring down the offence from first degree "murder" to "culpable homicide not amounting to murder", punishable under the Second Part of section 304, IPC.

Consequently, we partly allow the appeal; set aside the conviction of the appellant under section 302, IPC and instead convict him under section 304, Part II, IPC. The sentence of rigorous imprisonment for five years would meet the ends of justice.

3.10 Ballistics Evidence: Mis-appreciation[1]

Shortly stated the prosecution case was that one Pushu had two sons (i) Bhawan Singh and (ii) Bhag Chand. Bhawan Singh had no issue and he died leaving behind him his widow Smt. Rukmani Devi. Bhag Chand also died leaving behind him four sons; (i) Shivraj Singh, (ii) Indra Singh, (iii) Rajpal Singh (deceased) and (iv) Puran Singh (accused). All the four brothers (sons of Bhag Chand) were residing in a jungle at a distance of about two kilometers from village Akhori, Patwari Circle Barab, Tehsil Ukhimath, District Chamoli. There were frequent quarrels between accused Puran Singh on the one hand and other three brothers on the other hand in connection with the property owned and possessed by Rukmani Devi. According to the prosecution, Rukmani Devi had gifted her property by a registered gift-deed to accused Puran Singh depriving other three brothers from her share. On August 3, 1979 at about 4 p.m., PW5 Smt.

1. *Puran Singh* v. *State of Uttarkhand,* 2008 Cr LJ 1058 (SC).

Ramdei, daughter of PW4 Shivraj Singh who had come to her parental house at village Akhori was grinding paddy with her deaf and dumb mother Smt. Swanri Devi near her house. At that time, accused Puran Singh came towards the cattle shed of Shivraj Singh and started beating she-buffalo of Shivraj Singh. Smt. Ramdei and her mother raised an objection. Accused got enraged and caught the wife of Shivraj Singh by her hair in order to beat her. Shivraj Singh happened to reach there and cautioned the accused. The accused went inside the room, brought his licensed gun and fired a shot towards Shivraj Singh who luckily escaped unhurt. On hearing the noise, other two brothers of Shivraj Singh, PW2 Indra Singh and Rajpal Singh (deceased), came out to inquire as to what had happened. The accused started showing his anger towards them also. Both of them, therefore, decided to retreat from there. They were, however, chased by the accused who was carrying his gun. PW2 Indra Singh asked Rajpal Singh (deceased) to run fast so that they may be saved. Rajpal Singh, unfortunately, turned his face backward to see as to how far away was the accused from him. The accused fired and the gun shot hit Rajpal Singh on his face and head. Rajpal Singh fell down on the ground. In the meanwhile, PW3 Smt. Bardei, wife of Indra Singh and PW6 Bimala, minor daughter of Rajpal Singh along with other children and family members reached near the place of incident. They could thus see the incident. Indra Singh was threatened by the accused and he went inside his house and got himself saved. Rajpal Singh became unconscious and remained as such till he was declared dead.

Initially, a case was registered against the appellant-accused in the First Information Report (FIR) for an offence punishable under section 307, IPC as also for an offence punishable under sections 25 and 27 of the Arms Act, 1959. After the death of Rajpal Singh, however, the charge was framed for committing an offence punishable under section 302, IPC. The case was committed to the Court of Session, Chamoli. A plea of the accused was recorded wherein he denied to have committed any offence, and claimed to be tried.

In order to establish the case against the accused, the prosecution examined eight witnesses. Out of them four witnesses were eye-witnesses, *viz.,* PW2 Indra Singh, PW3 Smt. Bardei, PW5 Smt. Ramdei and PW6 Kumari Bimala. It also examined PW1 Pratap Singh-Pradhan of the village, PW7 Dr. D.C. Awasthi and PW8 Mitra Nand-Patwari.

So far as death of the deceased Rajpal Singh is concerned, there is no dispute that he died homicidal death and it was due to firearm injuries sustained by him. PW7 Dr. Awasthi, who performed postmortem, found the following injuries on the body of the deceased:

(1) Fire arm injury ½ cm in diameter circular in shape with inverted margins on right side of scalp parietal region, 5 cm above the top of right ear and 10 cm from the outer corner of the right eye with tattooing (impregnated black carbon particles) over an area of 12 cm x 10 cm over the right side of face, forehead and around the wound. It was wound of entry.

(2) Fire arm lacerated injury oval shaped 2½ cm x 1 cm with irregular everted margins 2 cm behind injury No. 1. Clotted blood was present around it. It was wound of exit.

(3) Fire arm lacerated wound 1 cm x ½ cm irregular in shape, 2 cm below and behind injury No. 2. It was wound of exit.

(4) Fire arm lacerated wound 1 cm x 3/4 cm irregular in shape, 2 cm behind injury No. 2. It was wound of exit.

It was, therefore, clearly proved by the prosecution that the death of deceased Rajpal Singh was homicidal in nature and it was because of the gun injuries sustained by him.

The trial Court considered the evidence of eye-witnesses and observed that except minor contradictions, there was no inherent improbability in their evidence. He, however, observed that from the evidence of Investigating Officer and the entries made in the Check Register that FIR and the relevant G.D. entries of the registration of the case, were made at a subsequent stage on some other date and not on August 3, 1979. There was thus 'every occasion for consultation and afterthought'. The trial Court also observed that the accused stated that Rajpal Singh (deceased) was injured by a shot fired from the gun carried by a co-villager (Bachan Singh) when the deceased had gone for hunting with his brother Indra Singh and Bachan Singh (co-villager). According to the trial Court, it might or might not be so but in view of suspicious circumstances, it could not be said that the prosecution had succeeded in establishing the guilt of the accused 'to the hilt and beyond all reasonable doubts'. In that view of the matter, according to the trial Court, the accused was entitled to benefit of doubt. Accordingly, the trial Court acquitted the accused.

Being aggrieved by the order of acquittal recorded by the Sessions Court, the State preferred an appeal under section 378 of the Code of Criminal Procedure, 1973. It was contended by the State that once the evidence of prosecution witnesses was believed by the Court and it observed that there was no reason to disbelieve the said evidence, the Court ought to have convicted the accused. It was urged that when the trial Court did not find material contradiction or inherent improbability in the prosecution evidence, the Court was wholly wrong in acquitting the accused.

The High Court reappreciated the evidence of witnesses and held that the order of acquittal recorded by the trial Court was wholly unsustainable and totally unwarranted. Accordingly, the High Court set aside the order of acquittal and convicted the accused-appellant herein for an offence punishable under section 302, IPC and ordered him to undergo rigorous imprisonment for life as observed earlier.

The accused has challenged the order of conviction and sentence recorded by the High Court by filing the present appeal. On April 10, 2006, appeal was admitted and notice was issued on prayer for bail. On November 24, 2006, when the matter was called out, the Court fixed final hearing of the appeal and observed that in view of that order, it was not necessary to deal with bail application. Appeal is accordingly placed before us for final hearing.

We have heard learned counsel for the parties.

The learned counsel for the appellant raised several contentions. In our opinion, however, it is not necessary to deal with all the contentions in view of the fact that the appeal deserves to be allowed on a short ground.

The learned counsel for the appellant urged that from the opinion of the Ballistic Expert, it was clear that the bullet which caused the injury to the deceased was not fired from the gun said to have been used by the appellant, recovered from him and was examined by the Forensic Science Laboratory. If it is so, the prosecution was not successful in bringing home the guilt of the accused and in establishing that it was the gun of the accused which had caused firearm injury to deceased Rajpal Singh which resulted in his death.

The learned counsel for the State, on the other hand, submitted that the point raised by the learned counsel for the accused in this Court was neither raised before the Sessions Court (Trial Court) nor before the High Court (Appellate Court). No such point, hence, can be permitted to be raised in this Court for the first time in an appeal under Article 136 of the Constitution.

We would have indeed considered the submission of the learned Government Advocate but for the fact that there is sufficient evidence on record to show that what is sought to be contended by the learned counsel for the accused in this Court has substance and sufficient material is already on record in support of such plea.

We have been taken by the learned counsel for the parties to the record of the case. Exhibit Ka.3 is the Arrest Panchnama dated August 4, 1979 when the accused was apprehended at about 8 a.m. in the morning. In the memo of arrest as also in seizure memo, it was stated that 'no article was recovered from the body of the accused and nothing was seized by the police'. The accused had nothing except wearing clothes. In Daily Diary by Patwari Circle, Barab, Tehsil Okhimath dated August 4, 1979, it was mentioned that the Patwari started to the place of occurrence from village Senagadmari at about 5.30 a.m. on August 4, 1979. At the place of occurrence, he found injured Rajpal Singh in the custody of villagers. The injured was breathing but was unconscious. The patwari tried to inquire about the incident from Rajpal Singh but the latter could not speak. Though treatment was given to the injured, he died. Inquest panchnama was thereafter prepared in presence of persons who were there. The FIR was registered under section 307, IPC on the basis of the report dated August 3, 1979 by Partap Singh, Pradhan, but Rajpal Singh died and the case was registered under section 302, IPC. It was stated that "as the death of the injured Rajpal Singh was caused due to intentional gun shot by accused Puran Singh S/o Bhag Chand, therefore, the accused Puran Singh is taken into custody and the weapon used in murder *i.e.* gun 1319/V-1970, Licence No. 697/Mly-74 and two empty cartridge Bore-12 recovered from the accused and sealed it at the spot in presence of witnesses".

Seizure Memo was prepared on the same day which reads thus:

> *"Today on dated 4-8-1979 in presence of (1) Shri Pratap Singh, Pradhan Village Panchayat Akhori, (2) Shri Bachan Singh S/o Ram Singh, (3) Shri Bhopal Singh*

S/o Tilak Singh, Village Akhori, Circle-Barab in the case No.4/79 State through Pratap Singh, Pradhan, Gram Panchayat Akhori versus accused Puran Singh S/o Bhag Chand, village Akhori, under section 302 IPC and 25/27 Arms Act, the licensed gun of accused called and ammunition was also called. Then the accused Puran Singh handed over to police his single barrel gun, bullet 12 bore No.1319 V-1970, licence No. 697/ML4/34-V, booklet, two empty cartridges on which KF-12 Special 12 is written made in India by ORDINANCE FACTORIES and it was seized by police. Accused was asked to handover other ammunition. The availability of which accused denied. When the gun was opened it was not loaded with cartridges. The above recovered article was put in separate sack/ packet and sealed. The memo was prepared in presence of witness and their sign was taken."

It is thus clear that even according to the prosecution, the weapon used by the accused for commission of crime *i.e.* causing death of deceased Rajpal Singh was recovered along with two empty cartridges. The mudamal gun as also empty cartridges were then sent to the Forensic Science Laboratory, Lucknow, which were examined by the Laboratory.

The prosecution witnesses who were cited as eye-witnesses and examined on oath have also stated that the gun used for commission of offence was recovered and the injuries were caused to the deceased by the accused from the said gun. For instance, PW2-Indra Singh was shown gun (Ext.1) and it was observed by the trial Court that "on seeing the gun Ex.1 the witness told that this is that gun from which Puran Singh fired bullet". Similarly, PW4-Shivraj Singh stated that it was the same gun. In para 6, it is observed; "Witness was shown Ex.Ka-1. He said that from this gun Puran Singh fired."

So far as medical evidence is concerned, PW7-Dr. Awasthi had to say this:

"In my opinion, the death was due to coma which was as a result of head injury caused by the discharge of some arm fire, which was sufficient in the ordinary course to cause death."

PW8 Mitra Nand, Patwari stated in his substantive evidence, that he went to the house of the accused and arrested him. He further stated that the accused gave him his licensed gun of single barrel twelve Bore (Ex.1) and two Cartridges (Ext.6&7) which were sealed separately.

The Report of Forensic Science Laboratory dated November 28, 1979 is also on record. It states that the Laboratory received a letter from Chief Judicial Magistrate, Chamoli (Gopeshwar) along with two 12 bore K.F. Special emptied cartridges marked as E.C.1 & 2 and one piece of gun 12 bore single barrel No.1319. It was then stated that the examiner fired five shots from the gun which were marked as T.C. 1 to T.C. 5, T.C.1, T.C.2 and T.C.5 misfired and rest fired successfully. Regarding E.C.1 and E.C.2, it was stated that there had been signs of firing pin. But on E.C.2, the signs were not specific. Cap of E.C.1 had sign of breach and E.C.2 had minor sign of breach. On the basis of the examination, a conclusion was given which is in the form of result which reads as under:

Result: (A) The cartridge in question E.C.1 was not fired from the single barrel 12 Bore No. 319 marked 1/79 gun.

(ii) The cartridge in question E.C.2 has no comparative feature with shot fired from gun No. 1319 12 bore marked 1/79.

(B) On the chemical examination of fouling matter from the gun the nitrate was found from the gun so it is concluded that after last shot the gun was not cleaned but on 3/8/79 whether or not shot was fired from gun designative scientific opinion is not a possibility.

It is thus clear that as per Ballistic Expert's opinion, cartridge E.C.1 was not fired from the single barrel 12 bore No. 1319 said to have been used by the accused. In our opinion, therefore, the appellant accused is entitled to benefit of doubt.

For the foregoing reasons, the appeal deserves to be allowed and is accordingly allowed. The order of conviction and sentence recorded by the High Court is set aside and the appellant is given benefit of doubt and is ordered to be acquitted. Since the appellant is in jail, he is ordered to be released forthwith if his presence is not required in any other case.

The appeal is accordingly allowed.

Appeal Allowed.

3.11 Clinching Evidence[1]

There are certain other factors to which our attention has been drawn by the learned counsel. His submission is that the prosecution also rested its case on the fact that the cartridge which had been found and taken over by the investigating officer had been fired by the gun of the appellant. There is no controversy that 10 cartridges had been sold to the appellant at Varanasi, as it has also been admitted by the appellant himself in his statement under section 342 of the Cr.P.C. The seller of the cartridge, namely Santosh Kumar Mukherjee, has been examined in the case and he has proved the original cash memo which he had given to the appellant which has been marked exhibit 2. He had also brought the carbon copy of the cash memo. He also proved the sale voucher, which is Exhibit 3, and also the signature of the appellant thereon which were marked Exhibit 3/1. Learned counsel urged that the gun and the cartridge had been sent to the arms expert, who has been examined as P.W. 6 in the case. His evidence was required to determine whether the cartridge which had been seized was used in the gun produced by the appellant or not. The substance of the evidence of the expert (P.W. 6) is that on 25-7-1966 he had received a double barrel gun along with one fired cartridge case of 12 bore, manufactured by Eley of Great Britain. The gun was marked Exhibit 1 and the fired cartridge case was marked Exhibit 2. He found the left barrel of the gun coated with a quantity of fouling, indicating that it was fired previously and the gun was in perfect working condition. With the said gun he fired two cartridges and compared the three fired cartridges under comparison microscope and found similar striker and breech face markings on the percussion caps of the fired cartridges. He

1. *State of Bihar* v. *Hanuman Koeri,* 1971 Cr LJ 187 (Pat).

proved his report which was marked Exhibit 5, and explained that next to balls, L.G. shots were the biggest, having 6 shots in each 2½" cartridge.

3.12 Reliable Evidence[1]

Mr. M. Jauhari (P.W. 9) is the Assistant Director of Central Forensic Laboratory cum-Assistant Chemical Examiner to the Government of India in Calcutta. He is the ballistic expert to whom the rifle which was produced by the husband of the accused and the ammunitions which were seized from the accused's house with the Samiz, underwear and frock which were in the wearing of the deceased were sent for examination by the police along with the report of the post-mortem. He submitted his report Ext. P-7. He stated in court that after chemical examination he found that the rifle bore evidence of being fired before it was received by him. It was however not possible to give its duration. He examined the three garments. No blackening or charring was found around the hole in the garments. He could not give the distance of firing. The frock and the underwear were found to have one hole each corresponding to the wound on the left iliac fossa. No hole corresponding to the second wound on the tip of the left 12th rib could be found on any of the garments. P.W. 9 states that in the event of the frock hanging in the normal manner, this (observation) suggests the possibility that the holes in the garments are the holes through which the bullet entered before causing the wound on the left iliac fossa. According to him, it probably came out of the second wound of the left 12th rib but failed to penetrate the frock. The fact that the wound on the left 12th rib is located at a place where the body was not covered by the underwear could account for the absence of another hole in the underwear. He, however, stated that these observations needed confirmation in the light of observations made by the autopsy surgeon about the nature and appearance of the two wounds. Spectrographic examination revealed lead around the edges of the holes of the garments. The visual appearance of the holes was also similar to that produced by firing the ammunition seized from the accused's rifle (Ex. M. 4). He, therefore, concluded that the holes in the garments could be produced by .22 bore rifle shot. He stated in the course of cross-examination that due to loss of energy it is possible that the bullet may not have passed through the garments after passing through the body and hence might have fallen down at the place where the victim was hit. He fired seven rounds from the seized rifle for experiment and tested by firing one round on a piece of cloth taken from the frock. From the evidence of the doctor as well as the ballistic expert, it is established that the wounds found on the person of the deceased were caused by a bullet. We are also satisfied that the bullet was fired from the rifle seized from the accused husband. The ballistic expert fired one round from this rifle with a cartridge seized from the house of the accused through a piece of cloth taken from the frock and he has, therefore, sufficient materials on which he based his conclusion, and we are satisfied that it is safe to depend upon his opinion. We are also satisfied that the child died as a consequence of the bullet injury.

1. *Meera Puri* v. *State of Nagaland,* 1971 Cr LJ 539 (A&N).

In a case of causing death by firing, reported in AIR 1954 SC 271, *Sadhu Singh* v. *State of Pepsu*, the facts of which may be briefly mentioned: A, a Mahant, went to the house of B who was having a drink party. B was respectful to A and was over-anxious to show all hospitality to him. B was anxious that the Mahant should not go away from his house without taking meals and spending the night with him, and seeing that he was going away, in all probability B let go his gun without aiming it at the Mahant in order to prevent him from leaving his place by terrifying him to some extent. The shot hit A in chest and he died of the wound later on. On the above facts, their Lordships of the Supreme Court held, that:

On the materials placed on the record it could not be held proved that B had any intention of firing at the Mahant. He seems to have pulled the trigger without aiming at the Mahant in a state of intoxication in order to see that by the gun-fire the Mahant was prevented from leaving his place. It was a wholly rash and negligent act on B's part or at the worst was an act which would amount to manslaughter. It could not be held to constitute an offence of murder. B was, therefore, held guilty of an offence under section 304A, Penal Code and sentenced to imprisonment already undergone by him.

3.13 Indefinite Evidence[1]

The various matters mentioned in the judgment of the High Court on the question "*whether the shots were fired from inside the drawing-room or from outside*" are so convincing that one could not but come to the conclusion that the shots were fired from inside the drawing-room and not from outside. The various findings of bullet marks on the wall, the calendar, the door pane in the light of the evidence of the ballistic expert did not leave any scope for even a shadow of doubt that the doctor was hit by a gun fired from inside the drawing-room. The assailant at the time of firing was not and could not be visible to persons outside as the shots were fired from a place inside the drawing-room which was south-east of the western door. And that is the reason that Kalika did not say that he saw Shamim firing the shots at Gautam. He merely deposed to the fact of the former proceeding to the western room immediately after the firing. It may also be added that the fact that the shots were fired from inside the drawing-room was neither disputed in the High Court nor before us.

For the reasons stated by the High Court in its judgment, we unhesitatingly endorse its view that the shots were fired from the 20 bore DBBL gun which was recovered from the eastern room and the licence of which was in the name of Sikandar Jahan, stress was laid before us that P.W. 14, Sia Ram Gupta, the ballistic expert, had deposed with reference to the two empty cartridges found at the spot that the shots could have been fired from the 20 bore DBBL gun of Sikandar Jahan: the expert was not definite about it. We find no force in this.

3.14 Data Essential[2]

Coming back to the submission of learned counsel on the evidence of P.W. 6; I think that the submission must be accepted as correct. It also finds support from a decision of the Supreme Court in *Kalua* v. *State of Uttar Pradesh*, AIR

1. *Shamim Rahmani* v. *State of Uttar Pradesh,* 1975 Cr LJ 1654: AIR 1975 SC 1883.
2. *State of Bihar* v. *Hanuman Koeri,* 1971 Cr LJ 187 (Pat).

1958 SC 180. In *Kalua*'s case, the accused was convicted for the murder of the deceased by shooting him with a country-made (improvised) pistol. A cartridge was found near the cot of the deceased, and the accused was arrested fourteen miles away from his village which was the place of occurrence. He produced a pistol from his house in circumstances which clearly showed that he only could have known of its existence there. The evidence of the firearm expert showed that he had fired four test cartridges from the pistol produced by the accused. He found the individual characteristics of the chamber to have been impressed upon the test cartridges and that exactly identical markings were present on the paper tube of the evidence cartridge. He made photomicrographs of some of these individual marks on the test cartridges and the evidence cartridge, and gave his opinion that the cartridge found near the cot of the deceased was fired from the pistol produced by the accused. The High Court held, which was approved by the Supreme Court, that the firearms expert has made the necessary tests he appeared to have been careful in what he did. There was no good reason for disturbing his opinion. It would, therefore, appear that in the said case all the materials which had helped the firearm expert in coming to his conclusion were produced in the trial court and the High Court had the advantage of considering those matters and was satisfied that the firearms expert had carefully made the necessary tests. In the instant case, no material has been furnished and, therefore, we are unable to hold whether or not the firearms expert, namely, P.W. 6 had been careful in carrying out the necessary tests before giving his opinion as contained in the report and testified to the court. This is a serious infirmity in the prosecution case. The learned standing counsel had, however, urged that since P.W. 6 was not crossed-examined on these matters, it must be assumed that the method of examination by the expert of the gun and the cartridge was no longer open to doubt. There is no justification for this argument, because the prosecution is under duty to produce every scrap of material which would help in coming to a just decision in the case, irrespective of the fact whether those materials go against the prosecution or in its favour.

3.15 Unconvincing Evidence[1]

It seems that the learned judges of the High Court were not at all impressed by the evidence of the expert, which they characterized as unsatisfactory and they were not also confident that the gun (Ex. P-16) had been used in causing the injuries to Dalip Singh. This appears from the following observations made by them in their judgment:

> *The gun P-16 was identified by Jita Singh as the gun with which Mohinder Singh fired at him and Dalip Singh but he identified the 'gun' because of a brass plate of its butt end. We have seen the gun. Its brass plate could be of no use for the identification of the gun!*

Again commencing on the nature of injuries found on the body of Dalip Singh:

> *What kind of bullet it was which, though it had blackened the area where it entered the brain showing that it had been fired from not far away, did not shatter*

1. *Mohinder Singh* v. *State of Punjab*, 1953 Cr LJ 1761 (SC): AIR 1953 SC 415.

the brain, we do not know? What kind of projectile it was, which entered the body (which if the evidence is to be believed it was fired at from a few feet at Dalip Singh) and passed through the body without shattering the inside of the chest or causing extensive damage therein is also not known. Mr. Sethi (counsel for the accused) quoted Taylor's book on medical jurisprudence and Hatcher's book on ballistics and argued that the firing must have been from a place between 800 and 1,200 yards away in order that the projectile may pass through and through the body and not shatter it. That, of course, presupposes that the barrel of the gun (using the word 'gun' in the generic sense) is grooved which caused a projectile to go forwarded with a rotatory motion of something under a quarter of a million revolutions a minute and travelling at the rate of about 2,000 miles an hour when it leaves the gun. We do not know whether the barrel of this gun (Ex. P-16) is grooved or not. It is a single barrelled gun and is country made. The likelihood is that the barrel is not grooved.

On a careful reading of the judgment under appeal, it appears that the learned judges of the High Court strongly felt that they had no adequate explanation in the oral evidence before them for certain puzzling features of the injuries on Dalip Singh. This is exactly what we also feel in this case, and it seems to us that the evidence which had been adduced falls short of proof in regard to a very material part when an injury is caused by a lethal weapon, it has always been considered to be the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the alleged weapon. It is elementary that where the prosecution has a definite or positive case, it must prove the whole of that case. In the present case it is doubtful whether the injuries which are attributed to the appellant were caused by a gun or by a rifle. Indeed, it seems more likely that they were caused by a rifle than by a gun, and yet the case for the prosecution is that the appellant was armed with a gun and, in his examination, it was definitely put to him that he was armed with the gun (P-16). It is only by the evidence of the duly qualified expert that it could have been ascertained whether the injuries attributed to the appellant were caused by a gun or by a rifle and such evidence alone could settle the controversy as to whether they could possibly have been caused by a firearm being used at such a close range as is suggested in the evidence.

It is clear, and it is also the prosecution case, that only two shots were fired at Dalip Singh, and one of the crucial points which the prosecution, had to prove was that these shots were fired in such manner and from such distance as is alleged by the eye-witnesses. There is, in our opinion, a gap in the prosecution evidence on a most fundamental point and the error which has been committed by the courts below is to ignore the gap and decide the case merely upon the oral evidence of three witnesses, two of whom are mere chance witnesses and not altogether independent persons and the evidence of the third witness is open to criticism on the ground of his partisanship as well as the improbability of his having been able to see the firing at his brother after he had himself been shot at the back of the head. The learned judges of the High Court, after commencing upon the entire evidence, say in their judgments.

We are thus left with the evidence of three witnesses of the prosecution together with the state of wounds as shown by the medical evidence and an unsatisfactory statement of the expert.

They reject the evidence of the expert, and they consider the nature of the wounds to have created a serious difficulty in the case. Having arrived at this conclusion, it was a serious thing to rest the appellant's conviction wholly upon the oral testimony in the case which has remained unchecked and unconfirmed by expert evidence.

The real position appears to be that the prosecution case cannot be said to be wholly proved but only partly proved if it is permissible to use such an expression. This court, as was pointed out in *Pritam Singh* v. *The State*, will not entertain a criminal appeal except in special and exceptional cases where it is manifested that by a disregard of the forms of legal process or by a violation of the principles of natural justice or otherwise substantial and grave injustice has been done. It seems to us that the present case comes within the rule laid down because the appellant has been convicted notwithstanding the fact that the evidence is wanting on a most material part of the prosecution case.

4. ON PHOTOGRAPHS

4.1 Photographs Not Essential[1]

It has next been argued that although the evidence of the prosecution showed that eight shots were fired at the time of the incident, the High Court erred in accepting the opinion of Ramiah (P.W. 23), who was a Firearms Expert of the Tamil Nadu Forensic Science and Chemical Laboratory, Madras, that all of them were fired from one and the same firearm. It has been urged that as no "empties" were found at the place of the incident, the eight shots could not have been fired from a pistol and the expert's opinion that they could have been fired from a revolver should not have been accepted as, even according to him, such revolvers with eight chambers were rare. It has also been argued that the evidence of the expert could not have been accepted because he did not take photographs for the purpose of comparing the land and groove himself by their comparison under "comparison microscope".

We do not think there is any real basis for this argument. Even if it were assumed for the sake of argument that the crime revolver had only six chambers and an eight chamber revolver was not available for the commission of the murders, there was nothing to prevent the appellant from reloading the revolver after firing the first two shots on hearing which Smt. Nagammal (P.W. I.) came from the threshold of the bed room to the drawing hall. Ramesh (P.W. 23) has stated that if the person using the revolver had been an expert, he would have required about a minute to reload it. The prosecution has led satisfactory evidence to prove that the appellant was an expert who had taken regular training in the use of firearms and had passed it with credit. If it would take a minute for an expert to reload all the six chambers, it would have been taken less than that time in replacing the two cartridges which were used in the first two

1. *Ramanathan* v. *State of Tamil Nadu,* 1978 Cr LJ 1137: AIR 1978 SC 1204.

shots. As it is, the evidence on the record does not exclude the possibility of such a reloading, and when an assassin who has received training in the use of firearm transcends at night into the house of his enemies with the intention of murdering them, it would be quite natural for him to replace the discharged cartridges. Much would not, therefore, turn on the question whether the appellant used a six or an eight chamber revolver in the commission of the crime.

In support of his argument regarding examination under the comparison microscope without the aid of photographs, Mr. Anthony has placed reliance on *State of Gujarat* v. *Adan Fateh Mohmed Unatiya*, (1971) 3 SCC 208. In that case the expert did not take photographs of the misfired cartridges, and admitted that the photographs were necessary for comparison. In that context this court made a reference to Burrad's "***The Identification of Firearms and Forensic Ballistics"***, 3rd edition, 1956, page 175, where it has been stated that any evidence of identification which is unsupported by photographs cannot be regarded as being anything more than an expression of opinion, and held that it did not establish that the test cartridges and the empty cartridges were fired from the same weapon or that the misfired cartridges was fired from the same weapon. That was, therefore, a different case which was decided on its own facts. It also appears that there was no evidence in that case to show that the comparison had been made with the help of a comparison microscope. The evidence of the expert, therefore, suffered from an inherent infirmity and was not satisfactory.

Counsel for the appellant however tried to refer to some observation from Hatcher's "Firearms Investigation, Identification and Evidence" for the purpose of showing the importance of photography and the use of enlarged photographs in such cases. Hatcher has devoted a whole chapter to photography in investigation of firearms crime and while discussing the history of firearms identification he has pointed out the reasons why considerable importance was given to such photographs for the visual satisfaction of the judge and the jury. But while referring to the importance of photographs taken directly through the comparison microscope, he has devoted a paragraph to the decline in the use of micro comparison photographs and has gone on to state as follows:—

> *"There are also photographic reasons for the almost entire abandonment of this method of presentation. Unfortunately, the lenses of a camera do not adjust in the way that the human eye adjusts. The depth of field is extremely limited. Unlike the human eye, a photographic film has far less tolerance to variations in lighting. Photographs are almost always unsatisfactory to the expert who has made a positive comparison through the microscope. You photograph only what you can see at one single time. The camera cannot move along the surface of bullets to pick up identity after identity".*

The position has been stated as follows in section 178 (page 260) of Ehrlich and Jones' "Photographic Evidence, "1967, edition:—

> *"Usually more can be seen through a microscope than can be photographed through it. There are several reasons for this superiority of visual perception. In the first place, the eye looking through a microscope can scan the field and change focus at different points of the field. In addition, the eye can see any*

mental "filling in" is able to perceive form and detail that may not be recorded photographically. Moreover, the lens system of the microscope produces a curved field; this works out nicely for the eye since the retina is curved, but does not work so well photographically since the film plane is flat. Due to this latter defect, not all of the field will be photographed to the same degree of sharp focus, and some distortion may be produced in the photograph".

It cannot, therefore, be doubted that a comparison microscope is the most important and most widely used scientifically instrument in comparing the crime cartridge with the test cartridge. Such microscopes are of various types but they have been described as follows in Volume I of Mathews' "Firearms Identification" on page 38:—

"A comparison microscope consists essentially of two compound microscopes, having identical optical systems, so connected by an optical "bridge" containing a combination of prisms such that by viewing two separate objects (one under each microscope) through a single eye piece the two objects may be compared by bringing the images of parts of each into juxtaposition".

It has further been stated that when the desired condition is attained for purposes of comparison the bullets are said to be "matched", and correct opinion can be given thereon.

It is true that there has been considerable difference of opinion amongst investigators regarding the use of photographs in a court for the purpose of illustrating the matching of the markings, and while it may be that microscope photographs, when taken with the due care and in the best of conditions, may enable the evidence to be placed on the record in a visible form, it cannot be denied that court would not be justified in rejecting the opinion of an expert who has examined the markings under the comparison microscope simply for the reason that he has not thought it necessary to take the photographs. It is, therefore, not possible for us to reject the evidence of Ramiah (P.W. 23) who has categorically stated that he had compared the land and groove markings on the bullets under a comparison microscope simply because he did not think it necessary to take the photographs.

4.2 Photographs Desirable[1]

In these days when the technique of firearm identification has greatly advanced and the experts have advanced and sophisticated equipment in their laboratories, a heavy responsibility falls on the shoulders of the ballistics expert to assist the court in the administration of justice.

An expert witness in firearms identification cases should produce facts, and not opinions which cannot be checked. He should be able to say, "Here are my photographs: these are obvious points of similarity or difference; judge for yourself".

In the instant case the expert who was the head of the forensic laboratory of the State Government himself condemned the photographs which he earlier did not produce for use in the trial court and was made to produce in the

1. 1978 CLT 235.

High Court, by stating that it is not possible to give a definite opinion on the basis of the photographs that the bullets match each other and the photographs represent only a part of the picture and do not represent all the characteristics. If this is the position then any opinion based on these photo-micrographs cannot be depended upon.

He should give up this habit of presenting his bald opinion and incomplete photo-micrograph in courts. Such reports and opinions are of no use to the court and often lead in the breaking of very important links of prosecution evidence which are led by it for purposes of corroboration.

It may further be observed that there is no sufficient material on the record to rely on statement of the ballistics expert. This witness did not compare the characteristics marks on the percussion cap and breech face after getting the enlarged photographs to highlight the material on which he based his opinion. The reasons given by him for coming to the conclusion that the cartridge Exhibit P. 1 was fired from pistol Exhibit P. 2 are based on insufficient data. This witness in cross-examination admitted that he gives opinion in about 5 to 6 cases in a month. It is not understood as to why this witness failed to take the photographs of the Exhibits in question with a view to compare the points of similarity. It is really depreciable that even though this witness has to give opinion in 5 to 6 cases in a month only, yet he has not taken necessary steps to get the requisite data for forming his opinion. A Division Bench of this court in *Chuni Lal* v. *State of Haryana*, 1977 Cr LJ 57 did not place reliance on the testimony of this witness and for good reasons. In this view of the matter, we are not inclined to place any reliance on the recovery of the cartridge Exhibit P. 1 and that of the pistol Exhibit P. 2 and the expert opinion in this regard of P.W. 4.

4.3 Photographic data Desirable, not Essential[1]

The evidence of P.W. 26 is also attacked by the defence on the ground that he has not taken the microscopic photographs of the pin marks of the cartridges and furnished the other data of the microscopic findings shown by the diagrams to satisfy the court that the characteristic pin marks of the cartridges M.O. 15 recovered in this case are found to be identical with that of the test fired cartridges. In the case of *Ramanathan* v. *State of Tamil Nadu*, 1978 Cr LR (SC) 318: 1978 Cr LJ 1137, it is held by the Supreme Court as follows:—

It is true that there has been considerable difference of opinion amongst the investigators regarding the use of photographs in a court for the purpose of illustrating the matching of the markings and while it may be that microscopic photograph, when taken with due care and in the best of conditions, may enable the evidence to be placed on the record in a visible form, it cannot be denied that a court would not be justified in rejecting the opinion of an expert who has examined the markings under the comparison microscope simply for the reason that he has thought it necessary to take the photographs.

In view of this law laid down by the Supreme Court, the evidence of P.W. 26 cannot be rejected merely on the ground that he has not taken the

1. *S.G. Gundegowda* v. *State*, 1996 Cr LJ 866.

photographs of cartridges concerned. He has also explained that he could not take the photographs for want of films.

5. FRAUDS IN FORENSIC BALLISTICS

5.1 Cartridge Switched[1]

It is no doubt true in Ex. P. 29, it is seen that one fired 7.62 mm caliber cartridge case was not fired from the rifle examined by the ballistic expert. That rifle is marked as M.O. 1 in this case. Ex. P. 29 shows the following details:

> *"The following articles were received here on 24-2-1995 through police constable No. 2675 Thiru H. Jameel Basha, under unbroken seals which corresponded with the sample sent, viz:—*

A. One long gunny parcel containing Item 1, one 7.62 mm, calibre bolt action rifle bearing No. F 6044 and butt No. 646.

One gunny parcel containing, one ammunition carrying bag containing, Item 2, Fifty 7.62 mm calibre 'OFV-93' Cartridges in ten chargers.

One ammunition carrying bag containing Item 3, Forty Nine 7.62 mm calibre 'OFV-93' cartridges in ten chargers.

Item 4, one 7.62 mm calibre cartridge.

One paper packet containing,

Item 5, one fired 7.62 mm calibre OFV-93 cartridge case.

We examined the above articles and we are of opinion that:

(i) item 1 is a 7.62 mm calibre bolt action rifle; the cartridges, items 2, 3 and 4 and the cartridge case, item 4 are of 7.62 mm calibre;

(ii) the cartridges, items 2 and 3 and the cartridge case item 5 made in the Indian Ordnance factory; the cartridge, item 4 is of unknown make;

(iii) combustion product of any propellant was not detected in the barrel of the rifle, item 1;

(iv) test firing was conducted and the rifle, item 1 was found to be in working condition; four cartridges from item 3 were used up for test firing; (45 cartridges and 4 fired cartridge cases will be returned under item 3);

(v) the cartridge case, item 5 was not fired in the rifle item 1; (on examination under comparison microscope, the characteristic features of the marking of firing pin and breech were found to be different on the cartridge case, item 5 and the test cartridge cases obtained from the rifle item 1);

(vi) the effective range of the rifle item 1 is about 300 meters."

But the fact remains established that the deceased died due to gun shot wounds. P.W. 35 is the doctor, who had conducted post mortem on the dead body. Ex. P. 35 is the post mortem report. We have already extracted the symptoms found on the dead body from the post mortem report. The evidence of the doctor shows that injury number 1 is the wound of entry by a fire arm bullet; injury number 2 is the track of the bullet on the right lung; and injury

1. *Acit Boran Sam* v. *State,* 2006 Cr LJ 3786 (TN).

number 3 is the wound of exit by the fire arm bullet. The evidence also shows that injury number 2 is sufficient to cause death in the ordinary course of nature and those injuries could have been caused by a weapon like M.O. 1. Therefore, there cannot be any doubt at all that Abhey Singh died due to gun shot injuries. As rightly contended by the learned counsel for the appellant and conceded by the learned Additional Public Prosecutor, there is a doubt based on Ex. P. 29, whether the rifle produced in this case could have been used to fire the cartridge? There is medical evidence to show that Abhey Singh died due to bullet injuries. Having regard to the report Ex. P. 29, we have applied our mind to find out whether there is any other legal evidence to show that there was firing at the scene of occurrence. M.Os. 2 and 3 are the tin metal sheet and a wooden log recovered from the scene of occurrence. P.Ws. 9 and 12 speak about the recovery of M.Os. 2 and 3 from the scene of occurrence under Ex. P6 recovery mahazar. Ex. P. 4 is the observation mahazar, which shows that there is evidence of bullet piercing through M.Os. 2 and 3. Ex. P. 6 is the recovery mahazar itself, which also shows that in the above referred to two material objects, namely, M.Os. 2 and 3, there is evidence of entry of bullet. Ex. P. 22 is the requisition given by the investigating officer to the Court requesting, among other things, whether on M.Os. 2 and 3 there are evidence regarding entry of bullet, Ex. P. 28 is the report of the scientific expert, which we extract hereunder:

> *"The following articles were received here on 9-2-1995 through police constable No. CE 2675 Thiru Jameel Basha, under unbroken seals which corresponded with the sample sent, viz:—*
>
> *Item 1. One trunk of a tree with a bullet embedded*
>
> *Item 2. One metal sheet measuring 182.5 x 80.5 cm.*
>
> *There is an irregular hole on it.*
>
> *But the fact remains established that the there is an irregular hole on it.*
>
> *We examined the above articles and we are of opinion that:—*
>
> *(i) the irregular hold on the metal sheet, item 2 is caused by the impact of a bullet; the bullet has entered on the side marked "A" and exited from the side marked "B".*
>
> *(ii) one nose portion of a bullet, one tiny piece of the jacket of a bullet and five tiny lead pieces were extracted from the trunk of the tree item 1; all these are portions of a disintegrated bullet; the nose portion of the bullet is the jacket of a disintegrated 7.62 mm calibre bullet; it was fired from a 7.62 mm calibre rifle; it is void of any characteristic markings; hence it is not suitable for comparison and identification with any particular rifle."*

Ex. P. 28 shows that in M.O. 2, bullet has entered on the side marked 'A' and exited from the side marked 'B' and in M.O. 3 one nose portion of a bullet, one tiny piece of the jacket of a bullet and five tiny lead pieces were extracted from the trunk; all those are portions of a disintegrated bullet and the nose portion of the bullet is the jacket of a disintegrated 7.62 mm calibre bullet. Therefore, there are intrinsic material available on record itself that from the scene of occurrence, evidence of firing by a gun are recovered and M.Os. 2 and

3 contain enough materials, as referred to above, to show that bullet fired from the weapon entered in those two objects and from one of the objects, pieces of bullet have been recovered. Under these circumstances, we have no doubt at all to conclude that besides the evidence of P.W. 1 that his father was shot by the accused by using a weapon, there are materials on record to show that in the scene of occurrence there was a firing incident.

In the context of the contents of Ex. P. 29 that the fired cartridge could not have been fired from the rifle examined by the ballistic expert, can it be said that the entire prosecution case must fail? In Ex. P. 1, the complaint, P.W. 1 had only stated that he heard gun shots of bullet. Of course, he had stated in that complaint that he heard two or three gun shots. But in the oral evidence, P.W. 1 had stated that there was only one shot. In our considered opinion, this evidence of P.W. 1 as to how many shots were fired at his father — assuming it is at variance with the contents of Ex. P1, that he heard two or three gun shots, cannot be considered to be so very vital to affect his evidence *in toto*, P.W. 1 was a young boy. The occurrence was early in the morning and therefore when he lodged the complaint (Ex. P. 1), he would not have been in a position to say how many gun shot sounds he heard. Probably, this variation as indicated above may assume importance if the presence of more than one assailant at the crime scene is established. But the consistent case of P.W. 1 is that, there was only one assailant and that assailant is the accused before Court. In his evidence also, P.W. 1 had stated as hereunder:

> *"I saw the accused with gun in his hand; he fired one round at my father."*
>
> *"The accused had a long gun in his hand and M.O. 1 is the gun, which the accused was having at the time of shooting."*
>
> *"There was only one gun shot and I am sure of it"*
>
> *"I have not seen M.O. 1 after the incident and only seeing this day."*

He was examined in Court some time in the year 1999. The occurrence was on 5-2-1995. On the day when he gave evidence in Court, he was 21 years of age. Therefore from the mere admission in his evidence that "M.O. 1 is the gun which the accused was having at the time of shooting", it cannot be held that based on the contents of Ex. P. 29, the whole prosecution case must fall to the ground.

Mr. S. Shanmugavelayutham, learned counsel for the appellant, would vehemently contend that if the report of the ballistic expert do not show that the fired cartridge could not have been fired from the weapon produced in Court, the whole prosecution case must fall to the ground. For this purpose, he relies upon two judgments of the Supreme Court one is AIR 1953 SC 415: 1953 Cr LJ 1761 (*Mohinder Singh* v. *The State*) and the other is reported in AIR 1975 SC 1717: 1975 Cr LJ 1500, *Ram Narain* v. *State of Punjab*. In the first case, the Supreme Court held that where the prosecution case comes out with the positive case, then they must prove the entirety of the case and if they fail, the prosecution case must also fall to the ground. The Supreme Court in that case has held as hereunder:

"……

10. On a careful reading of the judgment under appeal, it appears that the learned Judges of the High Court strongly felt that they had no adequate explanation in the oral evidence before them for certain puzzling features of the injuries on Dalip Singh. This is exactly what we also feel in this case, and it seems to us that the evidence which has been adduced falls short of proof in regard to a very material part of the prosecution case. In a case where death is due to injuries or wounds caused by a lethal weapon, it has always been considered to be the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the weapon with which and in the manner in which they are alleged to have been caused. It is elementary that where the prosecution has a definite or positive case, it must prove the whole of that case. In the present case, it is doubtful whether the injuries which are attributed to the appellant were caused by a gun or by a riffle. Indeed, it seems more likely that they were caused by a rifle than by a gun, and yet the case for the prosecution is that the appellant was armed with a gun and in his examination, it was definitely put to him that he was armed with the gun P-16. It is only by the evidence of a duly qualified expert that it could have been ascertained whether the injuries attributed to the appellant were caused by a gun or by a rifle and such evidence alone could settle the controversy as to whether they could possibly have been caused by a firearm being used at such a close range as is suggested in the evidence."

The facts in the above case show that the victim — who died later on, was shown to have been fired by two assailants; one of the assailant was having a gun and the other assailant was having a rifle; the gun was exhibited as Ex. P. 16; two empty cartridges and a blood stained cap of cartridge were recovered from the place where the dead body was lying; the gun was produced by one of the assailants the appellant before the Supreme Court was shown to be armed with a gun; the incriminating objects recovered from the place where the dead body was lying were examined by a forensic expert and that his opinion was that they could not conclusively say whether the incriminating objects recovered from the place, where the dead body was lying, were actually fired through the gun (Ex. P. 16) or a similar gun or guns. The nature of injuries available in that case were also taken into account. In the context of the factual scenario, namely, two assailants having two different weapons, one having a rifle and the other (appellant in the appeal) having a gun; the injuries found on the dead body and entertaining a doubt as to whether the gun would have been used at all by the appellant in that appeal, the Supreme Court had held as extracted above. In the light of the above peculiar facts and in the light of the facts available in the case on hand where there is no dispute whether one assailant or more than one assailant was involved, we are of the respectful opinion that the judgment, of the Supreme Court referred to above would not apply to the case before us.

In the last case referred to above, it appears that the prosecution case was inconsistent with the medical evidence as well as with the evidence of ballistic expert only on one ground (*i.e.*), whether the injuries were due to firing once

or twice. There was no dispute regarding the nature of weapon used. Learned Additional Public Prosecutor brought to our notice the judgment of the Supreme Court to sustain that the contents of Ex. P. 29 showing that a weapon like M.O. 1 could not have been used to fire in this case, could not vitiate the prosecution case in its entirety. Learned Additional Public Prosecutor relied upon the judgment reported in AIR 1994 SC 1029: (1994 Cr LJ 1374), where the Supreme Court has held as hereunder:—

> "……
>
> *7. P.Ws. 4, 5 and 6 have been cross examined at length. Except eliciting some omissions in respect of minor details they have not been shaken. So far as the medical evidence and the expert evidence in respect of nature of the weapons used and the distance from which the shots were fired, are concerned, we do not come across any serious infirmity in the prosecution case. The Doctor, P.W. 1 who conducted the post-mortem, has stated that the injuries found on the deceased must have been caused by fire-arms. As a matter of fact some pellets also were removed from the body. Therefore there cannot be any doubt that the fire-arms were used. He was cross examined but he asserted that the distance from where the pellets were recovered from the entrance wound on the head may be more than 6" and that injuries Nos. 1 and 2 were caused from a very close range. In view of this positive evidence even if some of the recovered weapons as per the ballistic expert's evidence could not have been used, that by itself is not a serious infirmity. The eye-witnesses have categorically stated that country-made pistols were used and the medical evidence shows that the death was due to Injuries caused by fire-arms. This aspect has been considered by the Sessions Court in detail and it has been rightly observed that the shots have been fired from country-made pistols. There was every possibility of the holes caused being slightly bigger than muzzle. We have carefully gone through the evidence of the eye-witnesses and reasons given by the two Courts for believing their evidence. We see absolutely no grounds to come to a different conclusion. Accordingly, the appeals are dismissed."*

In the light of the above judgments, let us apply our mind as to whether on the basis of Ex. P. 29, the prosecution case can be totally -disbelieved. For deciding this point, we will have to find out whether there is any description of the weapon said to have been used by the accused in firing at the victim. In Ex. PI, P. W. 1 had stated that only he heard gun shots. In Ex. P. 35 post mortem report, the doctor opined that death is due to gun shot injuries. In his evidence also, the doctor had stated that it is a fire arm bullet. What is recovered and produced in Court by the investigating agency is a service rifle marked as M.O. 1 in this case. We have already referred in the earlier portion of the judgment the evidence of stores in-charge, who had deposed based on records, that besides giving a service rifle, the accused was also given 100 rounds of cartridges, when he was deputed for election duty to Patna. The accused was arrested on 6-2-1995 in Nandal in Maharashtra. It is no doubt true he was found in possession of 100 rounds of cartridges, but a close scrutiny reveals that out of 100 rounds, the accused had 99 cartridges which has the necessary details of having been issued by CRPF and one does not belong to the description

found in the other 99 cartridges. There is evidence to show, as we have already referred to earlier, that whenever ammunitions are issued to a CRPF personnel, it would be issued from the same lot and there is no scope for issue from different lots to one individual. Therefore, it is clear that out of 100 rounds of cartridges issued from an authenticated stores, the accused has accounted only for 99 such cartridges and he has not accounted for the remaining one. But however, he is found to have made good the shortage by being in possession of a different cartridge, for which possession, he had no explanation at all. As noted earlier, P.W. 1 was doing only + 2 at the time of examination and he may not know the difference between a gun and a rifle. But he had stated gun shot and probably in common parlance, he had called it as a gun. But the medical evidence shows that it is a gun shot wound. Ballistic expert report shows that rifle M. O. 1 could not have been used to fire the fired cartridge. Not only there is oral evidence of P. W. 1 that his father was fired at by the accused, but also there are intrinsic, inherent materials available in the spot itself about which we have already referred to earlier, which shows that at the scene of occurrence there was firing by a weapon. The accused is not a total stranger to weapons. In view of the overwhelming materials available in the evidence of P. W. 1 and the materials recovered at the spot, we have no doubt at all that the accused had used a fire arm in firing at the victim, resulting in his death. The medical evidence is in total corroboration to the oral evidence of P.W. 1 that his father died due to gun shot injuries.

For all the reasons stated above, we find no merits in the appeal and accordingly it is dismissed sustaining the judgment under challenge.

5.2 Fraudulent Evidence[1]

In regard to Harchand Singh, however, we have considerable doubt whether he was present on the scene at all. He is said to have been one of those present at the time when a brawl took place with Kehar Singh at Mandi Ahmedgarh, and his presence and involvement in the murders is sought to be established by the allegation that he was armed with a double barrelled breech loading gun, that as Jit Singh was passing mounted on his mare Harchand Singh exhorted his co-accused not to spare Jit Singh and simultaneously fired two shots at Jit Singh. As Jit Singh lowered his head, it is said, the shots missed him. Two empty cartridges are alleged to have been found subsequently about five karams from the body of Jit Singh. Learned counsel for the appellant has referred us to a report of the Forensic Science Laboratory Chandigarh, indicating that the two cartridges had been fired through the right barrel of the gun. If this be true, then plainly they could not have been fired by Harchand Singh. It is not the case of the prosecution that the gun was reloaded, after the first shot. There was considerable dispute before us whether the report could be accepted in evidence. It is urged for the appellants that the document was not received when the trial had started and that it was handed over to the court two days later without informing the defence about it. There is no doubt that if the report is accepted it goes a long way to demolishing the case of the prosecution against

1. *Harchand Singh* v. *State of Punjab,* 1981 Cr LJ 466 (SC).

Harchand Singh. Even if this material be discounted there is such inconsistency in the prosecution evidence against Harchand Singh that it forms an insufficient basis for convicting him. Indeed an attempt was made to prove that he had motive for participating in the attack by alleging that his uncle Karam Singh, had brought a woman from village Manki, who had been restored to her brother by Kehar Singh, and for that reason Harchand Singh had harboured acute ill-feeling towards Kehar Singh. This allegation was made by Sarwan Singh (P.W. 4) for the first time in his statement during the trial and not before. Then it is difficult to believe that, having regard to the distance from which the two shots are said to have been fired by Harchand Singh, he could have missed Jit Singh. The explanation given by the prosecution evidence in that regard is unacceptable. The two shots are said to have been fired at the commencement of the assault and it seems inconceivable that the mare, which does not appear to have been injured by any gun fire, should not have bolted after the shots were fired, and should have permitted the remaining appellants, who were on foot, to overtake Jit Singh and hack him down with their *gandasas*. The story set up by the prosecution appears improbable.

5.3 No Reliable Evidence[1]

Punishment for attempt to murder—Available evidence only of the injured and of another one, a professional and chance witness—Claim of the injured to have been admitted in hospital not mentioned by doctor witness—Pellets removed from injured not sent to police but given to a relative of the injured—Extraction of pellets not mentioned in doctor's report or entered in hospital register—Injuries recorded by police not tallying with doctor's report—Investigating Officer did not go to hospital to interrogate the injured..... Bloodstained clothes neither taken by police while taking report nor by doctor—Clothes, subsequently recovered, not sent for chemical examination—There is no reliable evidence to convict accused.

5.4 Chance (too many) Evidence[2]

Viewed in the background of the very suspicious story of the apprehension of the respondent on the 22nd March, 1970 at Agroha turning the story of snatching the fore-end of the gun by Manphool becomes very doubtful. From the evidence it is not clear how far this Agroha turning is from village Kajla. But Jagdish, P.W. 10, it is interesting to find, happened to be at Agroha turning just by chance although he is a resident of a village 20 miles away from there. He is also related to the deceased. He was a witness to the seizure of the gun from the person of the respondent at Agroha turning. His evidence was too crude on its face to inspire any confidence as to the arrest of the respondent at Agroha turning with the *Phatiless* gun. The High Court, in our opinion, has wrongly accepted this evidence as against its rejection by the trial court. It is strange that Sis Ram could find the respondent present at the Agroha turning just by chance and P.W. 10 also a ready witness by chance. In this background the suggestion on behalf of the respondent that his licensed gun was taken away

1. *Madan Singh* v. *State of Uttar Pradesh,* 1980 Cr LJ (NOC) 116 (All).
2. *Bahal Singh* v. *State of Haryana,* 1976 Cr LJ 1568 (SC).

from his house soon after the occurrence in the same night although not proved by any evidence, does cast doubt on the prosecution story as to the manner of Manphool's catching hold of the *Phatti*. P.Ws. 4 and 5 are also licenced gun holders. If the story of separation of the *Phatti* on Manphool's punching upon the respondent was correct, the three persons present at the scene of occurrence, if at all they were present, could have succeeded in catching the respondent with his gun. It was a single barrel gun and after one shot was fired it could not be reloaded on detachment of its fore-end.

6. REPORTS

6.1 Database[1]

In *State of Maharashtra* v. *Damu*[2] it has been laid down that without examining the expert as a witness in court, no reliance can be placed on an opinion alone. In this regard, it has been observed in *State (Delhi Admn.)* v. *Pali Ram*[3] that "no expert would claim today that he could be absolutely sure that his opinion was correct, expert depends to a great extent upon the materials put before him and the nature of question put to him".

In the article "Relevancy of Expert's Opinion" it has been opined that the value of expert opinion rests on the facts on which it is based and his competency for forming a reliable opinion. The evidentiary value of the opinion of an expert depends on the facts upon which it is based and also the validity of the process by which the conclusion is reached. Thus the idea that is proposed in its crux means that the importance of an opinion is decided on the basis of the credibility of the expert and the relevant facts supporting the opinion so that its accuracy can be cross-checked. Therefore, the emphasis has been on the data on the basis of which opinion is formed. The same is clear from the following inference:

> ***"Mere assertion without mentioning the data or basis is not evidence. Even if it comes from an expert. Where the experts give no real data in support of their opinion, the evidence even though admissible, may be excluded from consideration as affording no assistance in arriving at the correct value."***

6.2 Unsatisfactory, Non-scientific Bald Opinion[4]

The gun, Ex. 3, recovered from the appellant was muzzle-loading gun. In the muzzle-loading gun there is no opening at the clear end and essential ingredients like projectiles and gun powder are loaded separately through the muzzle end and rammed. It is designed to fire spherical projectiles which may consist of single ball or multiple projectiles known as shots/pellets, depending upon their size. Identification from fired shots/pellets has a poor chance of success. The chance of learning something definite from shots/pellets is negligible. Nothing

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1. *Gurjinder Singh* v. *State of Punjab*. Supreme Court: Criminal Appeal No. 1237 of 2008., DOJ: 18-2-2011.
2. AIR 2000 SC 1691.
3. AIR 1979 SC 14.
4. *Gopal Singh Gorkha* v. *State of Uttar Pradesh,* 1991 Cr LJ 1239.

can be proved by ballistic evidence. As a general rule, the expert will not be frequently called upon to work on such projectiles.

In the instant case the Ballistic Expert Sri Prem Singh (P.W. 6) fired two shots on the trousers of the injured and on a comparison of two holes created by these shots with the one already there, opined that the earlier hole could be caused by the pellet recovered from the calf of the injured. This is highly unsatisfactory and cannot be said to be the opinion of an expert.

An expert opinion in fire arms identification case should produce facts and not opinion which cannot be checked. Being the head of the Forensic Science Laboratory, the expert should know his responsibility towards the administration of criminal justice. He should give up the habit of producing his bald opinion. The expert should, if he expects his opinion to be accepted, put before the court, all the materials which induced him to come to his conclusion so that court, although not an expert may form its own judgment on these materials. Bald opinions are of no use to the court and often lead to the breaking of very important links of prosecution evidence which are led for the purpose of corroboration.

The opinion given by Sri Prem Singh, Ballistic Expert, is bald and there is no data or reasons to arrive at the conclusion that the hole already there on the trousers of the injured could be caused by the pellet extracted from the calf of the injured. There is no opinion that the pellet extracted from the calf of the injured could be fired from the gun, Ex. 3, belonging to the appellant, nor could it be possible for the expert to give such an opinion because the gun was muzzle-loading gun. The size of the shot recovered from the calf of the injured is .5075". There is no evidence of the size of the shots that were fired by the expert. The shot extracted from the calf of the injured was admittedly not fired by the expert in the test firing. Thus his opinion that the hole found on the trousers of the injured could be caused by the pellet extracted from the leg of the injured cannot be accepted. This opinion cannot be called as an expert's opinion so as to corroborate the ocular evidence on record.

If the opinions of the Doctor and of the Ballistic Experts are ignored then the only evidence left is of the injured himself and of the two witnesses namely Tara Dutt Bhatt (P.W. 2) and Pani Ram (P.W. 3). As has been stated above Tara Dutt Bhatt (P.W. 2) is admittedly the uncle of the injured. He claims to have gone along with the injured to see she-buffalo at a nearby place and while returning this occurrence took place. But these facts are wanting in the FIR. Similarly, P.W. 3 Pani Ram has stated that the appellant was abusing him and assaulting him on the main road. The injured Hari Charan Bhatt and the witness Tara Dutt Bhatt who were returning after seeing-she-buffalo saw this occurrence and accosted the appellant that he had become old enough to come out on the road and hurl abuses. These facts are also wanting in the FIR. These facts appear to have been introduced in the evidence simply to make the presence of Tara Dutt Bhatt and Pani Ram probable at the time of occurrence. A suggestion has also been given to Pani Ram that he was 'Halwaha' of the injured. In these circumstances the oral testimony does not repose much confidence.

It is also noteworthy that if the prosecution version is correct, the quarrel was going on between the appellant and Pani Ram. There was no occasion for the injured Hari Chand Bhatt to intervene and to pass any remarks against the appellant. This also makes the prosecution story highly unbelievable.

Thus, a close scrutiny and analysis of the entire prosecution evidence show that some facts which were wanting in the FIR were introduced in the evidence in order to make the presence of Tara Dutt Bhatt (P.W. 2) and Pani Ram (P.W. 3) more probable. The occurrence took place in the evening on road when admittedly a large number of persons were present but none of them was examined. A great suspicion arises from the cuttings and over-writings in the injury report and Bed Head Ticket and also from the discrepancy in paras 4 and 5 of the Expert's report, Ex. Ka-2. Opinion of Ballistic Expert cannot be said to be an expert opinion and has to be discarded outright. Enmity between the injured and the appellant is admitted. In these circumstances, the possibility of false implication of the accused cannot be ruled out.

Before parting with the case it may also pointed out that the muzzle of the gun when it was recovered from the appellant was found full of rust which was indicative of the fact it was not used at all since long. P.W. 6 Prem Singh, the Expert did not make any chemical analysis of the ingredients found on the walls of the muzzle of the gun. He has vaguely denied that what was found on the walls of the muzzle was rust. It is significant to note that he has stated that the residuary remains on the walls of the muzzle after the firing of test shots on analysis were found to contain lead and nitrate. This is highly misleading. Analysis of such remains after firing of test shots was not needed. It is clear that the contents found on the walls of the muzzle before firing of the test shots were not examined and so it cannot be said whether it was rust or traces of ammunition. Probability that the muzzle of the gun was full of rust at the time when it was recovered from the appellant cannot, therefore, be completely ruled out. That negatives the prosecution case that it was from the gun of the appellant that the shot in question was fired.

It has come in evidence that only one shot was fired. No pellets were found around the place of occurrence. Only one pellet entered the calf of the injured. It also seems highly improbable that the appellant would have chosen such an occasion to hit the injured when by his side in close proximity 3 or 4 other persons were also sitting.

In view of the above discussion, the prosecution has not successfully proved its case against the appellant and so the conviction of the appellant on the evidence on record cannot be sustained. The appeal must, therefore, be allowed.

6.3 Delay[1]

It is significant to note in this connection that the gun and the cartridge had been received by P.W. 6 on 25-7-66, but his examination was not completed until 13-5-1967. He even admitted in his cross-examination that he might have

1. *State of Bihar* v. *Hanuman Koeri,* 1971 Cr LJ 187 (Pat).

commenced the examination a day or two earlier, though he did not remember the exact date of the commencement of the examination. This inordinate delay in the examination by the ballistic expert is to be deplored and it is unfortunate that in such serious cases, the expert does not attach sufficient importance for speedy examination and submission of his report. I might also mention that the occurrence in the present case having taken place between the 5th and 6th July, 1966, the charge-sheet could not be submitted until 25-7-1967, and the expert (P.W. 6) is largely to be blamed for this delay. It is to be hoped that the attention of the authorities concerned and particularly of firearms expert (P.W. 6) will be drawn to these observations, so that hereafter there may not be deplorable delay in such matters.

7. EVALUATIONS

7.1 Appraisal[1]

In regard to Balak Ram, there is a concurrent finding that the shot fired by him caused the death of Radhey and we see no reason for taking a different view. The evidence in regard to the part played by him is natural and consistent and is corroborated by the opinion of the ballistic expert. Such corroboration was lacking as against others. The evidence of the ballistic expert shows that the bullet (Ex. 27) which was extracted from Radhey's body was fired from the pistol (Ex. 5) belonging to Balak Ram. Mr. Anthony made a severe attack on the evidence of the expert and in order to show infirmities in that evidence he read out to us various passages from *The Identification of Firearms and Forensic Ballistic* by Major Gerald Burrard; J.S. Hatcher's *Test Book of Firearms Investigation, Identification and Evidence* (5th Edn., 1946) and Modi's *Medical Jurisprudence and Toxicology*. We have considered these submissions but are unable to see a reason strong enough to justify a reversal of the concurrent view taken by the two courts. The normal rule that this court does not reappraise evidence in such cases must apply.

Stated briefly, Mr. Anthony's contention is that the bullet (Ex. 25) which was recovered from the scene of offence must have been the one which after hitting Tribeni Sahai made an exit wound and since that bullet, according to the ballistic expert, could not have been fired from Balak Ram's pistol (Ex. 5), he cannot be held guilty for causing the death of Tribeni Sahai, Mr. Anthony says that the evidence of the eye-witnesses stands falsified by the evidence of the expert. The difficulty in accepting this connection is that there is no warrant for saying that the bullet Ex. 25 must be the one which passed through Tribeni Sahai's body.

Mr. Anthony spent considerable time in showing that the striations on the bullet (Ex. 27) which was extracted from Radhey's body are of a different pattern from the striations on the test bullets fired from Balak Ram's pistol. The evidence of the expert has been closely considered by the High Court and we consider their finding on this aspect as open to no exception.

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1. *Balak Ram* v. *State of Uttar Pradesh,* 1974 Cr LJ 1486: AIR 1974 SC 2165.

7.2 Appraisal of substantial Evidence[1]

The State of Punjab has preferred the appeal by special leave and has contended that the learned Sessions Judge was right in finding the respondents guilty of the various offences and in convicting and sentencing them. And that the High Court had overlooked some important incriminating evidence and circumstances in reversing the order of conviction and sentence rendered by him. The learned Sessions Judge has accepted the evidence of P.W. 3 and P.W. 4, who, according to the prosecution, were eyewitnesses to the murderous assault being in the company of the deceased at the time of his assassination. Their evidence on its own strength appears to be sufficient to warrant a finding of guilt. The High Court seems to have resorted to unwarranted hair-splitting and had disregarded their testimony by making a somewhat casual and irrational approach. In any view of the matter, what places the matter beyond the clouds of reasonable doubt is circumstantial evidence of unimpeachable character which clinches the guilt of three of them *viz*. Bhura Singh, Chand Singh and Dasuandha Singh. If the totality of the evidence—direct and circumstantial—is taken into account, there is no escape from the conclusion that the Sessions Court was absolutely right in recording the finding of guilt against them. And the High Court was altogether unjustified in interfering with the order of conviction and sentence which was unassailable on merits in so far as it concerned them. The following facts have been firmly established:—

(1) The aforesaid three respondents were persons who held a licence under the Arms Act.

(2) Each of them owned and possessed gun under the authority of the said licence.

(3) Admittedly the licensed gun belonging to each of these three respondents has been used in the commission of the offence of murder of deceased Gurbachan Singh.

(4) The evidence of the Forensic Expert (P.W. 5) clearly establishes that the empty shells of cartridges which were found from the scene of offence soon after the Police arrived and made a search and seizure were fired from the gun belonging to the respective respondents.

(5) Each of the gun belonging to each of them had been recently used. The empties found from the scene of occurrence were found to have been fired from one or the other of the three guns.

(6) Each of the accused had produced recently fired gun along with the respective licence before the investigating officer in the presence of witnesses.

(7) All the three guns belonging to the three respondents have been used in the commission of the crime.

The implication of these circumstances may now be spelled out. Since each of the guns used in the commission of the crime was a licensed gun belonging to each of the respective respondents, the possibility of the weapon having

1. *State of Punjab* v. *Bhura Singh*, 1984 Cr LJ 1457 (SC).

been planted was altogether excluded. The respondents have not explained under what circumstances the licensed guns belonging to them which in the normal course were expected to be in their possession, came to be fired recently. So also they have altogether failed to explain as to under what circumstances the cartridges came to be fired from each of the three guns so that the empties were found from the scene of offence. In other words, they have not explained how the firearms which were of their ownership and expected to be in their possession came to be used in the commission of the murder. The owner of a licensed gun would normally keep it in a secure place so that it is not used by unauthorised persons and that no mishap occurs on account of an accidental firing of the gun. Even the gun is accessible the cartridges would not be accessible and the place where the cartridges are kept would ordinarily be known only to the licence-holder. If some one had surreptitiously taken away the gun, and somehow laid his hands on the cartridges, the same would not have quickly come back into the possession of the licence-holder, nor would he have been able to produce the recently used gun so soon. The probability of any such thing having happened even to one individual is insignificant. But when this has happened in respect of each one of the three respondents, the probability of anyone other than the licence-holder having fired it can be virtually excluded with safety. On probabilities the conclusion is inescapable that the gun in question was fired by the respondent who was a licence-holder particularly in the absence of any explanation coming forth from the licensed owners of these guns. It was a fact within their exclusive knowledge. And while they were under no compulsion to explain under what circumstances the licensed gun belonging to each of them came to be used in the murderous assault, the failure to explain the circumstance forges the link that completes the chain. When such an incriminating piece of circumstantial evidence is viewed in the light of the eloquent circumstance that the respondent concerned has no explanation other than silence to offer, the matter leaves no room for doubt, let alone a reasonable doubt, regarding the complicity and guilt to the three respondents. And when circumstantial evidence of such significance does not stand in lonely isolation, the matter assumes an extremely sinister complexion.

The said evidence is supplemented by the evidence of the two eye-witnesses PWs. 3 and 4 which connects the three respondents with the crime. The oral testimony of these two witnesses finds ample corroboration from the circumstantial evidence which by itself as discussed earlier, is sufficient to bring home the guilt to the three respondents.

7.3 Synergy: Expert Evidence & Eyewitness Account[1]

We have found earlier that the High Court had discarded the evidence of eyewitnesses on superficial and insubstantial grounds. Apart from the fact that there were no justifiable ground for rejecting their testimony we are greatly impressed by the evidence of P.W.I. and the substantial corroboration received by it from the First Information Report and the medical and the expert evidence.

1. *Gurnam Kaur* v. *Bakshish Singh,* 1981 Cr LJ 34 (SC).

An examination of the First Information Report shows that Bakshish Singh was responsible for firing two shots at Karam Singh and one shot at Gurdeep Singh. He was alleged to have shot once at the legs and later again at the neck of Karam Singh and one on the right thigh of Gurdeep Singh. The medical evidence supports the evidence of P.W.I. and what is more important the medical evidence is in tune with the First Information Report. The empty cartridges, which were found at scene of occurrence show that two of them found near Karam Singh and one found near Gurdeep Singh were shot from the pistol of Bakshish Singh. The manner in which the medical evidence and the expert evidence fit in with the earliest version given by P.W.I. in the First Information Report, to our mind, justifies our placing implicit reliance on her evidence.

7.4 Expert Evidence corroborates Eyewitness Accounts[1]

Our attention has been invited to the evidence regarding the recovery of the firearms, and we have examined it carefully. It has not been disputed that Mukund Singh was arrested on January 6, 1972, and was found in possession of single-barrel 12 bore gun Ex. P. 22. Malkiat Singh was arrested the same day, and was found in possession of double-barrel 12 gun Ex. P. 23 for which he held a licence. Appellant Kartar Singh was arrested on January 7, 1972 and he was then in possession of double-barrel 12 bore gun Ex. P. 20 for which he held a licence. Darshan Singh (P.W. 3) was arrested on January 10, 1972 and was found in possession of rifle Ex. P. 18 for which he held a licence. The aforesaid guns Exs. P. 23, P. 22, P. 20 and P. 18 were seized by the investigating officer, and were sealed. They were delivered at the Forensic Science Laboratory, Chandigarh, on February 3, 1972, J.K. Sinha (P.W. 14) Assistant Director of the Forensic Science Laboratory, Chandigarh has proved the delivery of the fired cartridge cases and the rifles in sealed condition, and he has stated that after firing test cartridges through the guns it was found that one of the recovered fired cartridge cases had been fired from Mukund Singh's gun Ex. P. 23 and four from Kartar Singh's gun Ex. P. 20. He has also stated that the two brass fired cartridge cases had been fired from Darshan Singh's gun Ex. P. 18. The witness has stated further that he came to the conclusion that they could not have been fired through any other firearms because every firing pin, and breech face mark has its own individuality. The counsels, for the appellants have not been able to make any substantial argument against the aforesaid recoveries of the fired cartridge cases and the firearms, and the evidence of J.K. Sinha (P.W. 14), which corroborates the testimony of the eye-witnesses in regard to the guilt of the appellants and petitioner Malkiat Singh.

7.5 Total Evidence consistent *inter se*[2]

Appellant Birpal Singh was carrying his licensed gun which was later seized by the police. On examining some of the empty cartridges the ballistics expert could give a definite opinion that his gun had been used in the occurrence. The prosecution evidence was consistent and did not suffer from any infirmity as to the guilt of this appellant. He fired his gun and caused injuries to Ram Lal

1. *Kartar Singh* v. *State of Punjab*, 1977 Cr LJ 214: AIR 1977 SC 349.
2. *Birpal Singh* v. *State of Uttar Pradesh*, 1977 Cr LJ 1738: AIR 1977 SC 2083.

on his chest resulting in his death. Conviction of Birpal Singh, therefore, under section 302 of the Indian Penal Code with a sentence of life imprisonment is perfectly justified.

7.6 Correct/Incorrect Inference[1]

During the course of investigation seven cartridges were recovered at the place of occurrence. One empty cartridge and one misfired 12 bore cartridge were found near the dead body of Tota Singh. Five empty cartridges were found lying on the southern Chabutari where Murti was washing clothes. A licensed DBBL gun was recovered at the instance of Gurdas Singh. An SBBL gun was recovered on being pointed out by appellant Bawa Singh. Four of the cartridges, according to the evidence of the ballistic expert, P.W. 13 Dr. M. Johari, had been fired from the single barrel gun recovered at the instance of Bawa Singh. Dr. Johari was definite that misfired cartridge were neither from the double-barrel gun of appellant Gurdas Singh nor from the single-barrel gun of appellant Bawa Singh. This clearly established the use of a third gun in the occurrence as was the prosecution case. Dr. Johari could not give any definite opinion about the other two empty cartridges as to whether they were fired from the DBBL gun of appellant Gurdas Singh. The findings of the ballistic expert and exemption of two persons from trial did create some confusion in the prosecution evidence and perhaps led the witnesses to make some changes or embellishments in their evidence. Nonetheless as found by the courts below, in material particulars the evidence of the eye-witnesses was trustworthy, credible and truthful.

7.7 Discrepancy in Versions[2]

The only point, which has been canvassed seriously before us by Mr. Umrigar who appeared in support of the appeal, is that the story put forward by the prosecution, namely that Thanni was killed by a pistol shot fired by Nawab Singh is materially contradicted by the medical report and the evidence of some of the prosecution witnesses. It is pointed out that the medical report shows that there were a number of gunshot wounds in the body of the victim and in Ex. P-6 it is clearly stated that an empty 12 bore cartridge was recovered from where the body of the victim lay. It is argued that in these circumstances the prosecution story, that Thanni was killed by a pistol shot fired by Nawab Singh cannot possibly stand; and in cases like this where death is due to injuries or wounds caused by a lethal weapon, it is incumbent upon the prosecution to prove by expert evidence, if necessary, that it was likely or at least possible for the injuries to have been caused with a weapon with which they were alleged to have been caused.

The point, it may be noted, was not raised before the High Court either during the hearing of the appeal or even at the time when the appellant applied for leave to appeal to this court. It seems to us that the point is without substance and the apparent discrepancy upon which the learned counsel lays stress appears on close examination to be wholly illusory. The prosecution story undoubtedly is that Nawab Singh carried a pistol with which he fired at Thanni.

1. *Gurdas Singh* v. *State of Rajasthan,* 1975 Cr LJ 1218.
2. *Nawab Singh* v. *State of Uttar Pradesh,* 1954 Cr LJ 738 (SC): AIR 1954 SC 278.

The pistol, however, was country made one and P.W. 6 expressly states that 12 bore cartridges could be fired in such pistols.

This story was accepted by the additional sessions judge and there is nothing improbable, therefore, in the recovery of a 12 bore exploded cartridge being found near the body of the victim, or in the presence of multiple injuries in his body. It is not the case of the prosecution that only one shot was fired by Nawab Singh. It may be further mentioned that the expression *gun fire* was used in the ordinary and colloquial sense by the prosecution witness and the evidence clearly indicates that they did not mean that the shot was fired from a gun and not from a pistol. The contention of the learned counsel must, therefore, fail.

7.8 Range of Fire[1]

The homicidal nature of the death of the deceased is not in dispute. The autopsy report of Dr. Prabhat Keshaw corroborates the homicidal nature of death. In his deposition, he stated:

> *"Rigour mortis present in all four limbs.*
>
> *Injury No. (i) One lacerated wound on occipital region on scalp 1½" x 1" x scalp deep.*
>
> *(ii) One lacerated wound on right side of chest at the length of second inter-coastal space 1½" lateral to the external margin 2" x 1" x cavity deep size, margin of wound charred and inverted, wound of entry.*
>
> *(iii) Third rib fractured.*
>
> *(iv) One lacerated wound on left side of back at bare area, just below the lower border of scapula 1½" x 1" x cavity deep size, margin of wound everted, wound of exit. Both injury No. II & IV are inter connected with each other.*
>
> *(3) On dissection, skull, brain and brain matter intact, right lung perforated, left lung intact, arch of aorata intact contents 3-4 ounces of undigested food materials, liver, splin, both kidneys intact, gasses ficle matters present in small and large intestine respectively. The bladder was half full. Time elapse since death within 24 hours.*
>
> *(4) In my opinion death occurred due to shock and haemorrhage caused by above noted injury caused by fire-arm. May be by rifle. The above noted injuries are sufficient for death. This post mortem report is in my pen and signature mark Exh. 4."*

In his cross-examination, he stated that the distance of firing was more than 6 feet and was from long range, *i.e.* beyond 6 feet; although he could not say the exact distance. He, however, could not state that the injury was from parallel height or from higher height. In regard to the presence of rigour mortis, it was stated:

> *"The start of rigour mortis depends on the temperature and weather conditions, but in this case rigour mortis developed after three hours. In all turn limbs developing of rigour mortis take 18 hours in such types of cases."*

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1. *Baso Prasad* v. *State of Bihar*, 2007 AIR SCW 801.

The deceased met instantaneous death. Although the investigation was conducted in a slipshod manner, but the presence of blood at the spot of occurrence as also seizure thereof had categorically been stated by PW-4, PW-5, PW-6, PW-7, PW-8 and PW-2. PW-2, Kapil Prasad, is an independent witness. He categorically stated:

> *"Blood stained soil and brick bats were also seized by the police in my presence and prepared the seizure list"*

It is, thus, not correct to say that no blood was found at the spot.

He reiterated his statement in the cross-examination in the following terms:

> *"The police seized blood stained soil, bricks etc. in my presence. I cannot say the length and breadth of the bricks. I do not remember the area of the place from where the blood was seized. The soil might be 4-5 hundred grams."*

We may also notice that in the First Information Report, it was categorically stated that the appellants herein had indulged in brick batting. The statement to the said effect was proved by PW-4, PW-5, PW-6, PW-7, PW-8 and other eye-witnesses in their depositions before the court. This part of the prosecution is not under challenge before us.

We may also notice the fact that there had been firing from the side of the appellants has not only been disclosed in the First Information Report but also stated by the witnesses. We would, however, examine the effect of the depositions of the said witnesses, in this behalf, a little later.

We may notice that according to PW-3, the firing took place from a distance of about 50-60 feet, whereas according to PW-4, the distance was anything between 40-45 feet. Both PW-7 and PW-8 stated that the distance from which the firing took place was about 40- 45 feet.

It is also not in dispute that whereas prosecution witnesses PW-4, PW-7 and PW-8 also stated that the appellants were in the second floor of their house, whereas the deceased, informant and others were in the first floor of their house. However, the difference of height of the respective buildings is not brought on records.

The discrepancies between the medical evidence and ocular evidence, however, as noticed hereinbefore, have been raised on two counts, namely, (i) rigour mortis in four limbs were found; and (ii) in view of the injury sustained by the deceased, the firing must have taken place from a close distance.

We must, however, state that before the High Court, the second contention was not raised. Even before the learned Sessions Judge the only contention raised was in regard to the time of death and with reference to the presence of rigour mortis in all the four limbs. In the grounds of the Special Leave Petition also, the question in regard to the possibility of the deceased having been fired upon from a close distance has not been raised.

So far as the contention in regard to distance of firing is concerned, it is true, ordinarily, charring would take place, if firing is done from a distance of

less than four feet[1], as has been noticed in some of judgments of this Court in *Subhash* v. *State of Uttar Pradesh,* (1976) 3 SCC 629; *Nath Singh* v. *State of Uttar Pradesh,* (1980) 4 SCC 402; *State of Punjab* v. *Wassan Singh*, (1981) 2 SCC 1 and *Sidharth* v. *State of Bihar,* (2005) 12 SCC 545.

In some cases, medical evidence may corroborate the prosecution witnesses; in some it may not. The court, however, cannot apply any universal rule whether ocular evidence would be relied upon or the medical evidence, as the same will depend upon the facts and circumstances of each case. No hard and fast rule can be laid down therefor.

It is axiomatic, however, that when some discrepancies are found in the ocular evidence *vis-a-vis* medical evidence, the defence should seek for an explanation from the doctor. He should be confronted with the charge that he has committed a mistake. Instances are not unknown where the doctor has rectified the mistake committed by him while writing the post-mortem report.

In *Surinder Singh* v. *State of Uttar Pradesh,* (2003) 10 SCC 26, it was held:

> *"One of the pleas raised by learned counsel for the appellants was that the injuries as noticed by the doctor are at variance with the ocular evidence. On a close reading of the evidence of eye-witnesses and the doctor's report there is no noticeable variance. The mere fact that doctor said that injuries appeared to be on one side of the body and the witnesses said that attacks were from different sides, is too trifle an aspect. When three persons are attacking a person, the witnesses naturally get shocked. This is normal human conduct and the immediate reaction is to save the victim and to stop the assailants from further attacks. That is precisely what has been done by the eye-witnesses. It is only when the medical evidence totally improbabilises the ocular evidence, that the Court starts suspecting the veracity of the evidence and not otherwise." [See also State of Karnataka v. Papanaika, (2004) 13 SCC 180].*

In *Anwar* v. *State of Haryana,* (1997) 9 SCC 766, this Court observed:

> *"It is true that Dr. Jai Kishan (PW 9) who conducted the autopsy in his post-mortem examination report described Injury 1 as being incised wound 20 cms x 2 cms causing fracture of the underlying bone. He further noticed lacerated wounds on the neck of the right ear of the size 1 cm x 1/2 cm causing fracture of the underlying bone. While giving evidence in the court, he described an incised wound as Injury 1 and lacerated wounds as Injury 1-A. He further testified that it was a bona fide mistake in not describing these two injuries separately. Mr. Sushil Kumar urged that Dr. Jai Kishan (PW 9) has made material improvement in his evidence before the court to suit the prosecution and to lend support to the evidence of eyewitnesses and, therefore, such an improved version which demolishes the evidence of eyewitnesses be not accepted. This submission, is an attractive one but having regard to the facts and circumstances of this case, it is not possible to accept the same. The consistent evidence of both these eyewitnesses*

1. Charring does not place beyond a few inches in case of hand guns, it can go beyond in case of long-barrelled firearms. Medicolegal experts are no Ballistics experts. Opinion about the range of fire is in the domain of Forensic Expert. **(Author's Note).**

was that A-2 had fired from his pistol on Baddal causing firearm injuries on his head and this evidence, in our opinion, is quite a credible one. Both these witnesses have referred to the firearm injury on Baddal on his head whereas lacerated wounds were found behind the right ear. In an assault of this nature, the exact description as regard to location of the firearm injury might be not accurate but that by itself would not render their evidence untrustworthy. It needs to be mentioned that the medical evidence is an opinion evidence which is used to lend corroboration to the evidence of eyewitnesses. If the medical evidence is found to be totally inconsistent with the ocular evidence on a given set of facts, it would be permissible for the court to reject the ocular evidence. As far as the facts of the present case are concerned as pointed out earlier, the inconsistency between the ocular evidence and the medical evidence is of a very minor nature and we do not think it proper to reject the evidence of these two eyewitnesses on that score."

Whereas in the body of the post-mortem report, the medical expert stated, 'the margin of wound charred and inverted' at another point, he in no uncertain terms stated that firing was done from long range and distance of firing would be from more than six feet. The possibility, therefore, of his commission of some mistake in the post-mortem report cannot be ruled out. It was on the said premise, it was incumbent upon the defence to bring the said fact to the notice of the doctor. Probably, knowing the futility of asking such a question, no such contention was raised either before the Sessions Judge or before the High Court. No such ground has also been taken before us.

Tattooing or charring shall depend upon the constituents of the propellant charge. It is in that context only wounds are classified by their external appearance as close contact, near contact and distant.

The doctor in his evidence was categorical in stating that the wounds would not come within the purview of classification of near contact; but the wounds should be classified under 'distant contact'.

The authorities like Taylor and HWV Cox in their treatises, state in details as to how the post-mortem examination should be conducted.

The nature of the gun will also have a role to play. Unfortunately, the investigating officer did not make any attempt even to seize the gun. When the weapon was not seized, the question of examination of any ballistic expert would not arise. [See *Nirmal Singh* v. *State of Bihar,* (2005) 9 SCC 725].

Section 45 of the Indian Evidence Act, 1872 reads as under:

> *"45. Opinions of experts.*—When the Court has to form an opinion upon a point of foreign law or of science or art, or as identity of handwriting or finger impressions], the opinions upon that point of persons specially skilled in such foreign law, science or art, or in questions as to identity of handwriting or finger impressions are relevant facts. Such persons are called experts".

Opinion of an expert, therefore, is a relevant fact. The court may, thus, took the expert opinion into consideration. But appreciation of evidence is the court's job.

It is, thus, for the court to arrive at an opinion as to which part of contradictory expert opinion should be accepted or whether in a given situation ocular evidence should be believed in preference to medical evidence or *vice versa*.

In *State of Uttar Pradesh* v. *Krishna Gopal*, (1988) 4 SCC 302, this court has observed:

> *"It is trite that where the eyewitnesses account is found credible and trustworthy, medical opinion pointing to alternative possibilities is not accepted as conclusive. Witnesses, as Bentham said, are the eyes and ears of justice. Hence the importance and primacy of the morality of the trial process. Eyewitnesses account would require a careful independent assessment and evaluation for their credibility which should not be adversely prejudged making any other evidence, including medical evidence, as the sole touchstone for the test of such credibility. The evidence must be tested for its inherent consistency and the inherent probability of the story; consistency with the account of other witnesses held to be creditworthy; consistency with the undisputed facts; the credit of the witnesses; their performance in the witness box; their power of observation etc. Then the probative value of such evidence becomes eligible to be put into the scales for a cumulative evaluation."*

Yet again in *Dhirajbhai Gorakhbhai Nayak* v. *State of Gujarat*, (2003) 9 SCC 322, this Court held:

> *"As regards the alleged discrepancy between the medical evidence and ocular evidence, it is to be noted that a combined reading of the evidence of PW 9 who examined the deceased after he was brought to the hospital and PW 7 who conducted the post-mortem, it is clear that there is no discrepancy in the medical evidence vis-à-vis ocular evidence. Only in respect of Injury 1, there appears to be some confusion but that does not dilute the prosecution evidence. It would be erroneous to accord undue primacy to the hypothetical answers of medical witnesses to exclude the eyewitnesses account which has to be tested independently and not treated as variable keeping in view the medical evidence as constant.* (See *State of Uttar Pradesh* v. *Krishna Gopal*.)"

In *Birendra Rai* v. *State of Bihar*, (2005) 9 SCC 719, this Court observed:

> *"We do not attach much significance to the fact that some of the wounds showed an upward trajectory. A bullet may possibly be deflected if it hits a hard surface. The fact remains that all the shots fired have caused wound of entry as well as exit wound, and from the description of the wounds given by the doctor it appears that the firing was done from very close range. The evidence of the witnesses is to the same effect. They have clearly stated that they came near the deceased after firing took place. There was indiscriminate firing at the deceased who fell down after receiving the first injury. One cannot assume that the deceased was lying still in one posture after falling on the ground. He must have been writhing in pain when several shots were fired at him, and in that process several injuries were caused to him. So viewed, we find no inconsistency between the ocular evidence and medical evidence on record."*

It was further observed:

> *"It was submitted that if several shots were fired, some pellets would have been found at the place of occurrence. It is the case of the prosecution that no pellets were found. For this reason alone we cannot discard the case of the prosecution. If pellets were found at the place of occurrence it would have further strengthened the case of the prosecution, but in the absence of such evidence one has to rely upon the ocular evidence which if found reliable, may be acted upon."*

In *Nirmal Singh* (supra), it was held:

> *"Counsel then submitted that the prosecution has failed to prove that the dalan of the deceased was the real place of occurrence. This submission is based on the fact that no bloodstained earth was seized from the place of occurrence. It is true that no bloodstained earth was seized from the place of occurrence but there is also evidence of several witnesses including the investigating officer that no blood had fallen on the earth. Eyewitnesses explained that on receiving the injury the deceased pressed his wound with his hands whereafter a piece of cloth was tied around the wound which soaked the blood which may have come out. There was, therefore, no likelihood of the earth getting bloodstained. Counsel for the appellants submitted that the intestines were protruding as described in the inquest report, and in such a situation there must have been some bleeding. That may be so, but in view of the explanation offered by the prosecution witnesses it appears probable that no blood had fallen on the ground at the place of occurrence. In any event, if some blood had fallen at the place of occurrence which the investigating officer failed to notice, that by itself will not be fatal to the case of the prosecution. We must observe that the investigation in this case has been most unsatisfactory and the investigating officer was not conscious of his responsibilities. The bloodstained piece of cloth which was wrapped around the wound of the deceased appears to have been seized by the investigating officer, but when questioned as to why it was not sent for chemical examination, he answered that he had hung that piece of cloth on a guava tree in the police station. The statement is comical but discloses the utter non-seriousness with which the investigation was conducted. We had expected better from the investigating officer who was investigating a serious case of murder. However, for this reason we will not reject the case of the prosecution entirely."* [Emphasis supplied]

We, therefore, are of the opinion that the second contention of the learned counsel also cannot be accepted.

We, however, are not oblivious of one patent fact. In the First Information Report, the first informant, attributed the act of firing to Brijnandan Prasad and Sahdeo. PW-4, however, in his deposition before the court attributed the act of firing only to Brijnandan Prasad. According to him, other persons were only wielding rifles. Shivnandan Prasad fell down after receiving the gunshot and died. He in his cross-examination also attributed the act of firing only to Brijnandan Prasad. PW-5 although stated that all the accused had started firing but even according to her Brijnandan Prasad fired shot which had hit the deceased on his chest. Evidence of PW-6 is also to the same effect that the shot which had hit his father on the chest was fired by Brijnandan Prasad. PW-7 and PW-8 also named Brijnandan Prasad.

The prosecution case is that the dispute started on lighting of fire on a heap of straw. The accused allegedly hurled brick bats, which compelled the deceased to come to the roof to forbid them from doing so. Whereas Brijnandan Prasad alone fired a shot which had hit the deceased, there is no evidence brought on record to show that any other accused did so. No gun shot injury was suffered by any person. The deceased has also suffered only one gun shot injury. No sign of firing was found on the walls or any other part of the building. No cartridge was recovered.

Even no other person had suffered any injury by reason of hurling of brick bats. Having regard to the materials brought on records, we are of the opinion that in this case although the prosecution has proved the charge of committing the murder of the deceased, it has failed to establish that the accused had any common intention in relation thereto. Brijnandan Prasad alone was, thus, responsible therefor. Had the other accused shared common intention with Brijnandan Prasad, they would have also fired. No such evidence having been brought on record, benefit of doubt must be extended to the other accused persons.

7.9 Range from Pellet Spread[1]

On one material point range of firing of the gunshots which killed the deceased, the questions arise: From what distance the gunshots—which killed the deceased—were fired? Is the evidence consistent with the prosecution case of the gunshots having been fired from the wall of Kamraj's house which is at a distance of 38 feet? The medical evidence of the doctor P.W. 8 who held the post-mortem examination finding that there were as many as five gunshot wounds on the deceased all over the body–left lateral side of the forehead, left side abdomen lateral, left shoulder joint, upper third of the lateral side of the left arm, middle third of the right arm—is indicative of the wide dispersion of the pellets purporting to fix the distance from which the gunshots were fired.

In this context the evidence of the investigating officer P.W. 12 furnishes useful materials to fix the distance of the fatal gunshot firing. He found two pieces of lead were lying on the outer verandah of the deceased close to the wall; one lead piece was stained with lime and the other with green colour, which is wood paint, as it appeared to him, the wooden frame of the Jaffrey put on the verandah of the deceased was white washed with lime; M.Os. III and IV were the two pieces of lead, the two pieces of wads M.Os. VIII and IX were lying on the step to the outer verandah of the deceased; M.Os. III and VIII and IX were sealed in the presence of witnesses under the seizure list Ext. 24. The investigating officer also found three pieces of lead M.Os. V, VI and VII lying on the outer verandah of the house of P.W. 10, Pravakar and close to the wall on the verandah, a piece of was M.O. X was lying on the step to the outer verandah of P.W. 10, Pravakar; M.Os. V, VI, VII and X were seized in the presence of witnesses under the seizure list Ext. 25. The investigating officer also found a small hole in the bottom part of the wooden frame of the Jaffrey put on the verandah of the deceased; cut and seized that part of the wooden frame

1. *Kishore* v. *State of Orissa,* 1967 Cr LJ 1155: AIR 1967 Ori 118.

which is M.O. XXII. Further he found two small holes on the outer side of the wall of the deceased that stands on the outer verandah; similarly he found two small holes on the wooden frame of the Jaffrey put on the verandah of P.W. 10, Pravakar standing on his outer verandah. These small holes on wooden frames and on the walls indicate marks of violence by gunshots. The investigating officer cut and seized bottom parts of the wooden frame of the Jaffrey of P.W. 10, Pravakar containing the hole and these are M.Os. XX and XXI, he seized the cut pieces of wood M.Os. XI, XII and XIII in the presence of the witnesses under the seizure list Ext. 26.

The significance of all these seizures made by the investigating officer read with the medical evidence of five gunshot wounds on different parts of the body is that it shows that fatal gunshots were fired from such a distance as it consistent with the width of the Rasta between the step of the deceased's house where the deceased was hit with the bullet and the road side wall of the house of accused Kamraj.

The question of distance of gunshot firing is considered from the point of view of certain recognised medico-legal principles, namely these. When a firearm is discharged from a distance, there will to total absence of the characteristics of a 'near' discharge; ingraining of unburnt particles of powder is absent if fired from beyond ten feet; at a distance of twelve to fifteen feet, there is an absence of a main wound as all the pellets enter individually covering an area of about ten inches in diameter; at this distance the pattern formed by the entering shot will consist of small groups at a distance of thirty feet all the shots enter as individual pellets without any grouping and cover an area of about twenty inches in distance; these examples must of course be considered as a general guide in determining the distance at which the weapon was discharged; there are so many circumstances to be considered such as, length of barrel, choke or cylinder, black or smokeless powder, size of shots etc. (Cox's Medico-Legal Court Companion, 4th Edn., p. 33).

Considering the evidence in the present case in the light of the medico-legal principles, it is abundantly clear—from the manner the pellets from the gunshots dispersed widely all around—that the gunshots were fired from a distance more than thirty feet, namely, thirty feet, which is the distance of the accused Kamraj's road-side wall from the step of the deceased's house where the deceased was hit with bullets—pellets scattered or dispersed all around. The dispersal of the pellets speaks for itself about the distance.

In the ultimate analysis the question arises: Is the circumstantial evidence sufficiently strong to support the order of conviction under section 302/34 in this case? The position in law as settled by the Supreme Court is in substance this: Where there is no eye-witness to the murder and the case against the accused depends entirely on circumstantial evidence, the standard of proof required to convict the accused on such evidence is that the circumstances should be so far complete as not to leave any reasonable ground for conclusion consistent with innocence of the accused. It is true that in a case of circumstantial evidence not only should the various links in the chain of evidence be clearly established, but the completed chain must be such as to rule out a reasonable likelihood of the innocence of the accused. But in a case where the various links have

been satisfactorily made out and the circumstances point to the accused as the probable assailant, with reasonable definiteness and in proximity to the deceased as regards time and situation, and he offers no explanation, which, if accepted though not proved, would afford a reasonable basis for conclusion on the entire case consistent with his innocence, such absence of explanation or false explanation would itself be an additional link which completes the chain.

7.10 Self-Defence or Murder –Appraisal of Injuries[1]

For ascertaining as to whether or not the shots or missiles, which caused the injuries of Dial Singh deceased and Swaran Kaur, were discharged from the same cartridge, we called and examined Dr. B.R. Sharma, Director of the Forensic Science Laboratory, Chandigarh, in this court, to assist us with his expert opinion.

Dr. B.R. Sharma is definitely of the opinion that the two shots found in the parcel, Exhibit P. 1, *i.e.*, one extracted from the wall of Sardul Singh and the other picked up from near of house of P.W. Malagar Singh, had been fired from a 12 bore cartridge of standard L.G. size, while in the case of the third shot found in the parcel, Exhibit P. 2, the expert opined that it had been fired from a 12 bore cartridge of L.G. or S.G. size. The reason given by the expert, is, that the two shots found in the parcel, P. 1, weighed 4.41 grams and 4.24 grams, and that portions of lead from these shots had probably chipped off. The standard weight of L.G. and S.G. shots, according to the expert is 4.54 grams and 3.54 grams, respectively. The deformation of the two shots indicated that they had been fired from a gun.

As regards the shot found in the parcel, exhibit P. 2, the expert stated that it was in a greatly deformed condition and probably some of its lead had chipped off. Its weight was 2.76 grams, which weight was greater than the weight of a shot from any other cartridge of standard specifications than L.G. or S.G. The spherical shape of the undamaged portions of these shots indicated that they were factory-made. In an L.G. cartridge of standard size there are 6 shots, in all, while in an S.G. cartridge of standard size there are 9 shots. The diameters of L.G. and S.G. shots are 0.36" and 0.33", respectively. After examining the pictorial diagrams prepared by Dr. Satish Chandra and Dr. Jatinder Singh about the location of the wounds of Swaran Kaur and Dial Singh deceased, respectively, the expert explained that the shots during their passage through the body of Dial Singh, had suffered deformation, flattening and expansion by their impact with the bones and because of resistance of the flesh. This explains why the dimensions of two of the wounds on Swaran Kaur were greater in cross-sectional area than those of the entrance wounds found on Dial Singh.

Dr. B.R. Sharma was further asked that if in his opinion the injuries to both the aforesaid persons were caused by shots discharged from the same fire, why then the injuries to Swaran Kaur were at a lower level (just above and near about the knee) than those found on the deceased (which were at the level of the nipple). He replied that firstly, the shots had, after entering the body of Dial Singh, deflected downwards. This, according to the witness, was particularly

1. *Mohan Singh and Teja Singh* v. *State of Punjab,* Cri Appeal No. 414 of 1969 (P&H).

true in the case of injury number 1, the exit wound of which was at lower level than its entrance wound. Secondly, Dial Singh deceased must have instinctively ducked while receiving the shots or at the instant when the shots came out of his body.

It is in the evidence of Joginder Kaur, P.W. 5 that immediately after the gunfire the deceased was seen in a bending position and staggering with his hands placed on his wound towards the doorway of Malagar Singh. It was thus probable that the deceased at the time of receiving the shots, or, at any rate, a split second thereafter when the shots were coming out of his body, had by sheer reflex action dipped.

There is, therefore, nothing unbelievable in the categorical version of the eyewitnesses that Dial Singh and Swaran Kaur were hit by the same gunfire made by Mohan Singh.

Mr. Mahajan contended that the shape of the entrance wounds on the body of Dial Singh was quite circular, which meant that the victim was standing erect when he received those wounds.

This argument is not tenable. Firstly, the doctor has noted that the margins of these wounds were irregular, also. Secondly, the deceased might have started ducking simultaneously with the impact of the shots and continued doing so when the shots were travelling through his body. Furthermore, the shot which caused injury number 1, while travelling through the body of the deceased, had fractured the rib. It must have, therefore, deflected in its course. Even pictorial diagrams (which may not be very precise prepared by the doctor, show that the exit wound of this injury was at a somewhat lower level than its entrance wound. This gives some indication that the shots after piercing the body of Dial Singh, travelled in a somewhat downward direction.

It may also be noted that the distance between the deceased and Swaran Kaur at the time of the gunfire has not been fixed with precision. According to Karam Singh, P.W. 4, when the gun was fired he was standing behind Dial Singh deceased at a distance of about 4 Karams and Swaran Kaur was at a distance of one Karam from the witness. P.W. Malagar Singh has also stated that at the crucial moment, Swaran Kaur was standing in the lane towards that side where P.W. Karam Singh, his wife and mother were present.

In the note appended to the site-plan, Exhibit PN, it is mentioned that Swaran Kaur was at point number 3, at a distance of about one Karam from point number 1, where the deceased was hit. This note is obviously wrong. It does not conform to the evidence given by the witnesses at the trial. The distance between points 1 and 3, measured by a scale, is more than 1/2". The scale of the site-plan is 10 Karams equal to an inch. If the points 1 and 3 have been marked accurately, the distance of Swaran Kaur at the time of the gunfire from the deceased was about 4 or 5 Karams, *i.e.*, roughly 21 to 30 feet. Thus, even if the deceased had ducked only to a small extent when the shots hit him, then also the slightly downward direction of the shots coming from the body of Dial Singh could have hit Swaran Kaur in the region of the thigh and roundabout the knee. Effective range of an L.G. cartridge, fired from a 12 bore gun, according

to Dr. Sharma is 100 yards. It is in the prosecution case that Mohan Singh had fired at the deceased from a distance of about 4 Karams, *i.e.*, about 22 feet or so. Swaran Kaur, as already discussed, was about 4 Karams behind the deceased. This means, she was about 8 or 9 Karams, *i.e.*, about 50 feet or so, from Mohan Singh appellant, at the time of firing of the shot. The very fact that four of the shots had pierced through the body of the deceased, while lending assurance to the ocular account of the prosecution witnesses with regard to the distance from which the gun was fired, also strengthens the inference that those shots were of a relatively high-powered cartridge, most probably of an L.G. cartridge. Shots of an L.G. cartridge fired from a distance of about 20 or 25 feet could, even after piercing through the body of the deceased, have enough power left in them so as to cause fracture of the femur bone of Swaran Kaur. The circumstance that they did not pierce through the body of Swaran Kaur further shows that their velocity at that time was lower than what it was at the time of hitting Dial Singh.

The story that the deceased was also armed with a pistol which he first fired at Teja Singh but injured Swaran Kaur and then had reloaded the same and was about to fire same at Mohan Singh, does not inspire confidence. It has an aura of improbability. If the deceased had come to assist Karam Singh against Teja Singh and others when Karam Singh, according to the defence allegation, was assaulting Teja Singh, then there is no reason why a shot allegedly fired by the deceased from such a close range failed to find its mark on Teja Singh. It is nobody's case that the deceased or any other person on the complainant side wanted to harm Swaran Kaur who was standing near P.W. Karam Singh. If the shot which hit Swaran Kaur had been fired by the deceased, who was also quite close to Karam Singh—there should have been blackening, tattooing or charring around the wounds of Swaran Kaur. No such blackening, etc. was noticed by Dr. Satish Chander, absence whereof also indicates that the shots which hit Swaran Kaur had been fired from a distance beyond 6 feet.

7.11 Appraisal of Contradictory Evidences *inter se*[1]

The third contention was the one which Mr. Dixit elaborated. His proposition was that the medical testimony contradicted the eye-witnesses' version and that contradiction rendered their account unacceptable. According to Dr. Ghosh's evidence, none of the three entry wounds showed any blackening or tattooing. Obviously, therefore, the firing did not take place from a very close range but some distance at least. No doubt, the three eye-witnesses gave different distances ranging from two to six paces. But they could hardly be expected to have marked at the time the precise distance at which the person shooting the firearm was. They, therefore, gave an estimate of the distance at which he was from the victim. It is no wonder that the distances they deposed varied. Nothing can, therefore, turn on such variation.

But counsel pointed out that injury No. 1 showed six entry wounds in the left back, injury No. 5, four such entry wounds in the thigh and injury No. 7 in the left leg, one such entry wound. According to him, therefore, eleven pellets had actually hit various parts of the deceased's body, which fact must

1. *Janak Singh* v. *State of Uttar Pradesh*, 1972 Cr LJ 1177: AIR 1972 SC 1853.

indicate the extent of dispersal of the shot. He suggested that considering the area of dispersal the shot could not be single shot as deposed by witnesses, and secondly, that it could not have been fired from a short distance also deposed by them. In particular, he relied on the observation by the trial court that an S.G. cartridge contains nine pellets only and, therefore, the fact that the three entry wounds were caused by eleven pellets clearly suggested that there must have been at least two shots fired and not one. He also emphasised that the area of dispersal from the victim's back to her left leg also suggested that it could not have been one but two shots which could have caused all the three entry wounds with eleven pellets having caused eleven injuries at three different places. In support of his theory, he relied on the finding by the police (Ex. Ka 10) of five tiklis of cardboard and one flattened round shot at the well which according to him was again indicative of more than one shot having been fired at. It is clear that entire argument was based on the assumption of a wide dispersal of the shot.

The facts of the case and the evidence on record, however, do not support the assumption. The three entry wounds, besides the account given by the eye-witnesses, clearly established that the deceased was shot in her back from behind. If she was sitting, as described by the eye-witnesses, in a crouched position, her back, her left thigh and her left leg would more or less be, as already stated, in a perpendicular line. It will be noticed that injuries (v) and (vi) are entry and exit injuries *prima facie* indicating that the pellets which entered into the victim's left thigh penetrated through and through. The same is the position with regard to injuries (vii) and (viii) on her left leg. Two alternatives thus suggest themselves. Either that the same pellets which went through her left back (entry wound No. (i) and came out through the chest (exit wound No. (ii) hit the thigh and the coming out through and through also penetrated her left leg, both of which were in a line, or the three parts of her body were not in a straight line and different pellets dispersed from the shot penetrated the three limbs independently of each other.

In the case of the first alternative, there would be no question of a wide area of dispersal. In the case of second alternative, also, the dispersal would not be in any wide area. The site plan produced by the prosecution also makes it clear that there could not have been much distance between the victim and her assailant and, therefore, there was not much scope for any large dispersal of the shot. Such a conclusion is in harmony with the doctor's evidence, the places where the pellets entered into the victim's body and the evidence of the two eye-witnesses. It is true that in all at least eleven pellets entered into the victim's body at three places. The trial court observed that an S.G. cartridge would contain nine pellets. But as the High Court observed that was a personal observation made by the court without any such evidence. There was no evidence to show that the cartridge in question was an S.G. cartridge. No argument can thus be founded on an assumption that the cartridge was an S.G. cartridge. The police found five tiklis but they could be cardboard tiklis in which the pellets must have been packed. Their seizure by the police at the spot could not solve the question whether one shot was fired or more. Likewise, in the absence of

evidence as to what kind of pistol was used by the assailant, passages cited by counsel from works on firearms can hardly be of any relevance. The fact of the matter was that the eye-witnesses were emphatic that it was the appellant who fired at the deceased with a country-made pistol, and that he fired once only. That evidence was backed by the opinion of Dr. Ghosh who equally emphatically opined that all the six gunshot injuries could be caused by a single shot. That evidence was acceptable to both the courts and nothing has been substantiated before us which can justifiably impugn that evidence. Counsel could raise only conjectural alternatives as against the eye-witnesses' account as to how the incident occurred. Such conjectural alternatives cannot be substituted in place of accepted evidence of those who actually saw the incident.

7.12 Appraisal of Site Plan Evidence[1]

It may be mentioned here that the site plan, relied upon by the High Court to give 7 feet as the distance between the door and the place on the sofa where Thakar Singh was sitting, was prepared by a draftsman, Bakshi Singh, P.W. 10, on 24-2-1970, at a time when the sofa was not there at all. He admitted that he had shown the sofa and its distance from the door only on enquiry from the investigation officer. We do not think that such a statement could be admitted in evidence. Moreover, even if we assume, for the sake of argument, that this distance was 7 feet and, also that there was a chick, as deposed by the witnesses, the shooting could easily take place from a distance of 6 feet by inserting the barrel of the gun by the side of the chick and taking aim while taking the cover of the wall adjacent to the door. Dr. G.S. Gambhir, the medical officer, who had performed the post-mortem examination, said, after looking at the injuries of Thakar Singh: "These injuries were caused when the nozzle of the gun was at a distance of about 6 feet from the body. These injuries could not be caused if the nozzle was 4 feet away from the body. By nozzle I mean 'muzzle' of the gun barrel". He also said:—

> ***When the distance is less than 4 feet or 4 feet, the pellets enter the body en masse. If the distance is more than 4 feet, then the pellets will spread and will enter the body within a diameter of 2 inches from the main hole. In the present case there are three separate openings adjacent to injury No. 1 and there were four small openings around the second injury. I have not noted the exact distance of the various openings with regard to injuries Nos. 1 and 2. Up to a distance of 3 feet the pellets do not spread. My opinion is based on Modi's Medical Jurisprudence.***

The following injuries were found on the body of Thakar Singh:

> One circular wound about 2" in diameter with lacerated margins on the front of the chest, slightly on the right side of the middle line. There were three small separate openings adjacent to the main wound. One circular wound about 1½" in diameter with lacerated margin over the left shoulder joint. There were four small openings adjacent to main wound.

These injuries show that Thakar Singh's back was probably turned towards the door when he was first hit. Perhaps that is why he was first struck on his

1. *Datar Singh* v. *State of Punjab,* AIR 1974 SC 1193.

left shoulder joint. He must have turned slightly after the first shot. Hence, the other injury is on the front of the chest on the right side. If the assailant had actually entered the room and shouted "Thakar Singh" and shot, the injuries would be right in front. In that case, there could have been no injury on the left shoulder joint. It may be mentioned here that the F.I.R. lodged by Joginder Singh does not mention that the assailant had shouted 'Thakar Singh' before shooting at him. He admitted this omission but gave no explanation for it.

Medical evidence also revealed that there was no blackening, tattooing, scorching, charring or singeing around the main wounds. It was, therefore, contended before us that the shooting must have taken place from a distance of more than 4 feet. The High Court had explained the absence of blackening and charring by observing that the cartridges inside the gun bore the word "smokeless" and opined that the shooting need not have been from a distance of more than 4 feet. It seems to us that the High Court had assumed that the cartridges found in the gun were actually of a kind which would not cause blackening or charring or singeing and that these were the very cartridges used by the murderer. The requirements of a technically proper proof were wanting on this point. The ballistic expert, called in as a defence witness, was not even questioned on the point.

Here, we may refer to the evidence of ballistic expert Shri J.K. Sinha, D.W. 10, Assistant Director of the Forensic Science Laboratory, who was not produced by the prosecution probably because he had made a report showing that it was not possible to connect the cartridges with the gun as the impressions made by the hammer were too indistinct. The gun was proved, from its licence, to belong to Mohan Singh, the son-in-law of Thakar Singh. It was not sent for examination of any fingerprints on it. Had there been such evidence of the appellant's fingerprints on the gun, it would have furnished strong corroborative evidence. In the circumstances of the case, we find it difficult to link the gun with the actual weapon with which the murder was committed. It is not inconceivable that it was left deliberately outside by someone to confuse the investigating authorities.

7.13 Close-range Phenomena[1]

The prosecution case is when the deceased had gone upstairs with the dinner of the respondent, a sound of a gunfire was heard by the informant at the first floor. PW-3 rushed to the second floor immediately and found the deceased lying in a pool of blood on the terrace having a gunshot injury. Allegedly, he exclaimed "*didi ko kisee nei goli mar diya*". Hearing these words, the parents of the deceased also rushed to the second floor and found her lying on the terrace in the pool of blood with a gun shot injury on her forehead. The Respondent was seen hiding something by PW-2. When the mother of the deceased Gouri Devi (PW-2) took the deceased's head on her lap, the respondent also came out. She was brought downstairs and taken to a nursing home. The Respondent was also said to have accompanied them in a rickshaw. She was declared dead. Before the deceased was taken to the nursing home, PW-2 had locked the room from outside.

1. *Raj Kumar Prasad Tamarkar* v. *State of Bihar*, (2007) 10 SCC 433.

Information about the said incident was lodged by Raj Kumar Prasad Tamarkar, the father of the deceased (PW-13).

The investigating officer, on opening the lock, found a revolver from which smoke was still coming out. It was found from the bedstead of the room.

The respondent was arrested. Principal witnesses examined on behalf of the prosecution to prove the offence against the respondent before the learned Sessions Judge were PW-2, PW-3 and PW-13, mother, brother and the informant-father of the deceased respectively. Indisputably, they were present in the house when the occurrence had taken place. The autopsy report was prepared by Dr. Kaushlendra Kumar (PW-1) posted at Sadar Hospital, Giridih. He found the following injuries on the person of the deceased:

> *"(i) one circular lacerated wound over glabella (middle of forehead) ½" x ½" cranial cavity deep with inverted margin, blackening and charring was present.*
>
> *(ii) Cresentric mark over the side of the nose (left) below left eye—nail mark. On further dissection—subcutaneous tissues under the lacerated wound on the forehead in middle i.e. Glabella region and the underlying frontal bone consisted a circular hole ½" x ½" Cranial cavity deep. On further dissection the meninges and the brain were lacerated and terro posteriorly with extra cranial blood clot. On bullet was taken out from the posterior cranial fossa. The bullet was sealed and handed over the investigating agency."*

Bharti Devi (PW-4) was the aunt of the deceased, *i.e.,* the brother's wife of the informant (PW-13). She was staying in the same house. She deposed that at the relevant time the respondent was staying in the house and he had come asking for Bidai of the deceased. Suresh Kumar (PW-3) is another brother of the informant living in the same house. He was informed by the informant that it was the respondent who was responsible for the death of his daughter (the deceased).

Kameshwar Prasad (PW-5) is another brother of the informant who was also living in the same house. He also supported PW-3. Bishwanath Sharma (PW-7) was a neighbour who came to the place upon hearing commotion. To him also the occurrence was reported by the informant. Kali Prasad Sao (PW-8), Shambhu Prasad (PW-9), Surender Sao (PW-10) and Ramdeo Prasad Yadav (PW-11) were witnesses of seizure of a blood-stained revolver from the bedstead of the room which was being occupied by the respondent at the relevant time. Shesil David Khalkho (PW-12) is a Sargeant Major. He had examined the seized revolver and opined that the same had been in a working condition and had been used recently. He examined himself as PW-12.

The learned Sessions Judge on the basis of the aforementioned evidence found the respondent guilty of commission of murder and sentenced him to undergo rigorous imprisonment for life.

The said judgment having been appealed against has been reversed by the High Court by reason of the impugned judgment. The High Court was of the opinion that the circumstances said to be obtaining in the prosecution case could not be said to have connected all the links in the chain. The High Court also noticed that there was no eyewitness to the occurrence.

The circumstances which have been found by the learned Sessions Judge to prove the involvement of the respondent in the case are as under:

> *"(i) The marriage between the accused-appellant and the deceased was solemnized some time prior to the occurrence and the accused appellant although visited Calcutta in course of his duty but he did not meet his wife Usha Devi, the deceased, in Calcutta while she was residing at her Nanihal at Bhawanipur.*
>
> *(ii) At the time of occurrence in the upstairs of the house only the accused appellant and the deceased were present. There was none other than them.*
>
> *(iii) Soon after the occurrence when the inmates of the house went upstairs hearing the sound of firing, the accused appellant-was in the room while the deceased, Usha Devi, was lying with gun shot injury in a pool of blood on the terrace and he was found concealing something inside the bedstead.*
>
> *(iv) On examination of the seized revolver it was found to be an able one and recently it was used as still there was smell of firing in the barrel.*
>
> *(v) The accused-appellant was having some illicit relationship with one lady, namely, Sahnaj and only with the ulterior motive of clearing his path of illicit relationship with Sahnaj, Usha Devi was murdered. A letter to that effect as alleged was written by the accused appellant to the deceased had been proved in the case."*

We have noticed hereinbefore certain admitted facts which we need not advert to once over again.

No positive defence was taken by the respondent. Merely a suggestion was given while cross-examining the prosecution witnesses that the deceased might have been killed by an outsider.

Our attention was drawn to a letter dated 30-10-1995 (Ext. 7) written by the respondent to the deceased. In that letter indisputably the respondent had warned the deceased of grave consequences if she continued to accuse him in regard to his affair with Shahnaj.

The learned Judges of the High Court opined that there was nothing to show that the revolver belonged to the respondent, particularly, when the same had not been sent to a ballistic expert nor the blood which was found thereupon was sent for chemical examination.

The High Court moreover opined that nobody had stated that the revolver was kept in the jhola which was carried by the respondent. It was furthermore observed that the room wherein the respondent was staying cannot be said to be in his exclusive possession and, thus, if anything incriminating had been found therein, the same could not 'finger towards the conscious possession" of the respondent. It was furthermore opined that the fired bullet recovered from the body of the deceased having not been sent for chemical examination along with the revolver to prove that the same had been fired from the revolver seized; there remained a gap constituting a missing link.

Ext. 7 was proved to be in the handwriting of the respondent. The contents of the said letter are not in dispute. It contained threatening to the deceased. She was warned of grave consequences even to the extent of killing her.

The conspectus of the events which had been noticed by the learned Sessions Judge as also by the High Court categorically goel to show that at the time when the occurrence took place, the deceased and the respondent only were in the bedroom and the terrace connecting the same. There was no other person. The cause of death of the deceased Usha Devi *i.e.* by a gunshot injury is not disputed. The fact that the terrace and the bedroom are adjoining each other is not in dispute.

The autopsy report shows that "a blackening and charring" existed so far as Injury No. (i) is concerned. The blackening and charring keeping in view the nature of the firearm, which is said to have been used clearly go to show that a shot was fired from a short distance. Blackening or charring is possible when a shot is fired from a distance of about 2 feet to 3 feet. It, therefore, cannot be a case where the death might have been caused by somebody by firing a shot at the deceased from a distance of more than 6 feet.

The place of injury is also important. The lacerated wound was found over glabella (middle of forehead). It goes a long way to show that the same must have been done by a person who wanted to kill the deceased from a short distance. There was, thus, a remote possibility of causation of such type of injury by any other person, who was not on the terrace. Once the prosecution has been able to show that at the relevant time, the room and terrace were in exclusive occupation of the couple, the burden of proof lay upon the respondent to show under what circumstances death was caused to his wife. The onus was on him. He failed to discharge the same.

The observation of the High Court that the respondent had not been proved to be in possession of the revolver cannot be accepted. The respondent at the relevant time was with the deceased. In the event, the death has been caused by an outsider, he could have shouted. He would have been the first person to point out to her in-laws as to from which side the shot was fired. Even he could have been the first person to offer his explanation to the investigating officer. He chose not to do so.

The respondent was found to be hiding something under the bedstead by his mother-in-law. It may be true that PW-3 brother of the deceased when he came to the room shouted that somebody had killed his elder sister but the same would not mean that even if the circumstances are so glaringly pointing out the guilt of the accused and accused alone, the same should be ignored only because of the said statement.

Other brothers of PW-13 including PW-4 came to the spot immediately. PW-7 who was the neighbour also came to the spot immediately after the incident. To them also the respondent did not offer any explanation. To them also he did not say as to how his wife had suffered a gunshot injury.

The prosecution case that while taking the deceased to the nursing home, the mother of the deceased locked the door from outside has not been disputed. The lock of the door was indisputably opened in the presence of the investigating officer. Recovery of the revolver being the weapon of attack is also not in dispute. The fact that the injury could have been caused only by the weapon in question

is also not in dispute. The same was not only found to be in working condition, it was also found by the investigating officer as also PW-12 that the same had been used recently.

We may also notice that the defence suggested that the deceased might have committed a suicide. It was furthermore suggested that some family members might have committed the offence. The learned Sessions Judge found, which finding is not questioned before us, that keeping in view the place where the dead body was found, the suicide theory is wholly improbable. The bangles of the deceased were found broken. If she had committed suicide in the room, it was impossible for her to run to the terrace. It was impossible that the pistol would be found hidden under a bedstead in the room which is admittedly at some distance from the place where the deceased was found lying.

It is difficult to accept the submissions of Mr. Banerjee that had the respondent fired the shot, he could have thrown away the revolver. Under what circumstances the respondent did so can only be a subject matter of surmises. It is well known that different persons behave differently in a given situation. It is just possible that even if the revolver had been thrown, the same would have been found immediately.

Mr. Banerjee contended that the room was not in the exclusive possession of the respondent. It may be that the room was not in the exclusive possession of the respondent in the sense that he had not been living there permanently but it had not been denied or disputed that at the relevant time the deceased and the respondent were alone in the room. No other person was present there. Even the witnesses were not cross-examined in that behalf. No suggestion even had been given to that effect.

It was argued that if the respondent intended to kill the deceased, he could have done so after 17-7-1996 *viz.,* after Bidai ceremony took place. The very fact that the respondent brought a revolver is itself a pointer to the fact that he wanted to kill the deceased at one point of time or the other. He might have thought that Bidai ceremony would be held on 13-7-1996 or 14-7-1996. When it was postponed, he might have found out an occasion to kill her. Under what circumstances, the occurrence took place is not known. The respondent, it would bear repetition to state, did not open his mouth. He was entitled to exercise the right of silence. That he did not offer any explanation itself may not be sufficient to conclusively hold that he was guilty of commission of the offence, but the legal position that the same would be considered to be a circumstance against him is not in dispute.

It is true that neither any fingerprint expert nor any ballistic expert had been examined. Even the blood found on the revolver had not been sent for chemical examination, but, in our opinion, the same by itself would not negate the circumstances which have proved the guilt of the respondent beyond all reasonable doubt.

For the reasons aforementioned, we set aside the judgment of the High Court and restore that of the learned Sessions Judge. The appeals are allowed. The respondent is sentenced to undergo rigorous imprisonment for life under

section 302 of the Indian Penal Code. He may be taken in custody forthwith to serve out the sentence.

7.14 Close-range Phenomena[1]

The nature of the wounds said to have been inflicted on account of the gun being placed on the chest and fired does not fit in with the allegation. It is true that the doctor was not questioned about it. In fact the doctor made the statement that these wounds were due to the gun being fired by being placed on the chest or from within a range of one yard. We are of opinion that in this the doctor was wrong and probably got misguided on account of the black margins of the wounds. The black margins of wound are never due to the firing of the gun from very close range but are due to something different. Taylor says at page 430 of his *Principles and Practice of Medical Jurisprudence,* Volume I, 10th Edition:

> ***The edges of the wound commonly show a narrow ring of discoloration due to the removal of a layer of epithelium by the passage of the bullet. The surrounding skin may be scorched or not, and there may be a zone of blackening or peppering with grains of powder, according to the distance from which the weapon was fired.***

And again at page 431:

> ***All entrance wounds, if examined, will be found to have a zone of denuded epithelium immediately surrounding the orifice. This is caused by the spin of the bullet and tends to dry and become discoloured shortly after death. It should not be confused with the marks due to powder for it gives no indication of range.***

And again at page 441:

> ***The bruised and dark appearance which a gunshot wound sometimes present, even when the weapon is discharged at a distance from the body has led to the supposition that this effect was due to a burn and that the bullet burnt the parts which it touched, but this idea is not correct. The projectile never becomes sufficiently heated to acquire the power of burning.***

Of course no scorching of the wounds could have been possible in this case when the victims had several cloths on, even if the firing had been from very close range. And that again shows that the doctor's opinion was due to the existence of black margins and not due to any scorching of the surrounding skin. Again Taylor says at page 430.

> ***We must distinguish between near wounds and far wounds. Usually when a weapon is discharged in contact with or within an inch or so of the body the gases which pass out with the bullet enter the tissues and thereafter expand causing tearing of the skin or clothes very often in the form of a cross or a split. Most of the powder is found inside the tissues, but there may be traces of blackening, burning and tattooing around the entrance hole—if the weapon is discharged at a short distance from the skin the effect of the gases is lost and the entrance wound look like a***

1. *Sheo Shankaer* v. *State of Uttar Pradesh,* 1953 Cr LJ 1400: AIR 1953 All 652.

hole which might be caused by pressing a lead pencil into the tissues. It is rounded with inverted edges and surrounded by a zone of singeing, blackening from the smoke and tattooing from the impaction of small particles of powder in the skin.

The clothes did not show such tearing or splitting. It is, therefore, clear from the condition of the clothes which the victims were wearing that the gun does not appear to have been fired by its being placed on the chest or very close to the chest after the victims had fallen down[1]. The position of the first two wounds on Girdhari is also not very consistent with the position of the gun. It is not expected that he would be lying on the left side when the gun would be so fired.

7.15 Direction of Fire[2]

Mr. Basi Reddy in a forceful argument advanced the theory that the wound inflicted on the body of the deceased could not have been caused, if the first accused took a conscious aim at him. In support of his argument he relied upon the statement made by the eye-witnesses before the committing magistrate to the effect that the first accused wrested the gun from the hands of the second accused. It is said that, in the course of the wresting, the gun must have gone off accidentally and hit the deceased.

Reliance is also placed upon the evidence of the doctor in support of this theory. The doctor, as P.W. 4, says that the wounds Nos. 4 and 5 were exit wounds at the same level and that the deceased must have been shot from within about 10 yards. In cross-examination he further adds that the entry and exit wounds were almost on the same level in line with the first lumber verterbra. But he concedes that it is possible that there was a slight deflection on hitting the vertebra.

The wounds found on the body were described by him as follows:—

(1) A circular wound 1½″ in diameter (edges inverted) 4″ from the umbilicus and 6″ from left nipple in the anterior auxiliary line (vertically paralleled to nipple line and a little away 1½″ to 2″) with a part of the intestine projecting outside the wound.

(2) An abrasion 1″ diameter leftwards to the first wound.

(3) A contusion 3″ x 2″ around the first wound.

(4) Five performed wounds 1½″ in diameter in the right side of the abdomen in the lumber region 3″ above the right iliac crest.

(5) A perforated wound 1¼″ in diameter in the right arm at the level of the medical condyle in the right humerus.

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1. In contact firing (as alleged in this case: 'placing the gun on the chest'), most of the ejecta enter into the body *en masse,* the outer edge and area around the hole may/may not get close range phenomena (Charring, blackening, tattooing etc.). Close/contact range shots, ordinarily, do not tear the skin/clothes where there is ample space for gases to expand (as in this case. Underneath the chest there is ample space for the gases to expand. Tearing of the skin takes place, some times, when there is hardbone under the entry point such as skull.) It is unfortunate these facts were not brought to the notice of the honourable learned judges. **(Author's Note).**

2. *T. Munirathnam Reddi (in re:),* 1955 Cr LJ 917 (SC).

Relying upon these wounds and the opinion of the doctor, it is contended that when a person shoots another of about the same height from a short distance on the side of abdomen, it is impossible to cause an injury which would cause wounds almost in the same level in line with the lumber vertebra.

To put it differently, the argument is that, if the first accused shot the deceased on the side of the abdomen, the bullet could not have passed in a straight line from one side to the other but should have passed only in the direction in which the gun was placed, *i.e.*, the wound should have been not in a straight line, but in a slanting direction. The learned advocate also made a demonstration with a gun showing that the trigger could easily be released with a slight pressure. It is true that, the wound might not have been caused in the manner now found on the dead body.

Even then, there is no guarantee that the bullet would pass only in a slanting direction corresponding to the way in which the gun was held, for there might have been a deflection of the bullet when it came into contact with the vertebra. The evidence has not made it clear that the trace of the wound was also in a straight line.

But we do not think it is advisable to speculate on the basis of theoretical considerations. The first accused is 19 years old and the second accused is 65 years old. They were pursuing the deceased. The first accused found his father's hand shaking. He took the gun from him and shot the deceased. The first accused obviously must have been in an emotional state and he could not have had an opportunity at the time to take aim as he would have done in ordinary circumstances when he would shoot an animal or bird. In the hurry, he would have taken the gun from his father and released the trigger immediately. It is not possible to say in what position he kept the gun when he released the trigger.

The fact that the witnesses stated that he aimed at the deceased cannot be taken to mean that he aimed at the deceased in the manner he would have done under ordinary circumstances. We cannot, therefore, reject the evidence of the eyewitnesses relying upon some theoretical considerations based upon the nature of the wound. We, therefore, hold that the first accused committed the offence of murder.

7.16 Reconciliation of Contradictory Evidence[1]

The appellant, who had a rifle with him shot at Labh Singh from behind his back as he was attempting to run away. Labh Singh died on the spot. The small intestines were torn up and the left kidney was found smashed. The circular wound of entry at the back of the deceased 1/4" in diameter, had burnt and inverted margins according to the doctor who conducted the post-mortem examination. The ballistic expert deposed that if there were burnt edges of the wound, the distance between the muzzle and the victim would only be a few inches and not more than nine inches. This opinion is in substantial accord with what is found in some of the text books on medical jurisprudence. For instance, it is stated in Taylor's *Principles and Practice of Medical Jurisprudence*, Vol. I, 10th Edn., at page 441, under the heading "Burning of the Wound":

1. *Santa Singh* v. *State of Punjab,* 1956 Cr LJ 930 (SC): AIR 1956 SC 526.

It is impossible to state rules as to the precise distance from which it is impossible to produce marks of burning, for this depends on the quantity and nature of the powder, the method of charging, and the nature of the weapon. It is unusual, however, to get marks of burning beyond a yard or a yard and a half with a shotgun, or at more than half a yard with a revolver.

According to the medical evidence, therefore, the shot was fired from very close range about 9 inches to a yard or a yard and a half but according to what was shown to the draftsman of the plan by the eye-witnesses the rifle was fired from a range of about 25 feet. This difficulty cannot be surmounted, as was sought to be done by the High Court, as the eye-witnesses were not giving an estimate of the distance but showed to the draftsman the particular spots where the appellant and the deceased stood at the time of firing. Thus, in the face of the medical evidence, the testimony of the eye-witnesses cannot be safely accepted.

8. FIREARM INJURIES

8.1 Appraisal of Post-mortem Report[1]

The case of the prosecution is that on 14th March, 1997 at about 8.00 p.m. in village Kudar Bagha, 4 persons including the appellants herein came near the house of the deceased. When the deceased emerged from his Angan and came to the dalan, appellant Ranjan Singh exhorted his companion, appellant Nirmal Singh to shoot the deceased, as a result of which appellant Nirmal Singh fired at the deceased and shot him in the abdomen. The case of the prosecution is that apart from the appellants, the other two were also armed, one with a country made pistol and the other with a lathi. Further case of the prosecution is that after the deceased was injured, the members of the family, who are the witnesses, chased them and while retreating all the three accused who were armed with country made pistols, fired at them but no one was injured. The assailants made good their escape. According to the prosecution, the motive for the occurrence was that 3 days before the incident deceased was returning to his house in village Kudar Bagha and while he was passing in front of the house of the appellant Nirmal Singh, the bundle carried by him on his head touched the roof of the house of appellant Nirmal Singh, which caused a slight damage to the tiles of his roof. This gave rise to an altercation and abuses were exchanged between the parties. It was on account of this incident that appellant Nirmal Singh bore a grudge against the deceased and committed the offence as alleged.

The dead body of the deceased was sent for post mortem examination which was first conducted by Dr. Gupta, PW-13 on 15th March, 1997 at 12.00 noon. Dr. Gupta found an incised penetrating wound on the right side of the abdomen of the deceased which according to him had been caused by a sharp cutting weapon. It appears that the informant was aggrieved by the finding of the doctor PW-13 who conducted the post mortem examination and complained to the Chief Judicial Magistrate that the post-mortem had not been fairly conducted. On

1. *Nirmal Singh* v. *State of Bihar*, 2005 Cr LJ 672 (SC).

the orders of the Chief Judicial Magistrate, a second post-mortem examination was conducted by a board of 5 doctors which included Dr. Ganesh Mahto, PW-12, the civil surgeon. The second post mortem examination was conducted on 17th March, 1997 at 5.30 p.m. The finding of the medical board was that there was an oval wound on the right lumber of the area of abdomen anteriorly, size about 2" x (1-1/2)" abdominal cavity deep. The margins were eaten away by the maggots. There was no evidence of blackening or tattooing on the abdominal wall around the wound or anywhere else on the body. The internal organs were in the stage of decomposition and partly eaten away by maggots. All the viscera of abdominal and chest cavity were palpated and dissected for search of metallic foreign body, but despite vigorous search no metallic foreign body could be found anywhere in the viscera or in the abdominal and chest cavity. The board could not give any definite opinion relating to injury on the body, but it recommended further detailed investigation and for that purpose recommended that the body be sent to the Department of Forensic Medicines and Toxicology, Patna Medical College Hospital, Patna. Accordingly, the body was sent to the Patna Medical College Hospital and on 20th March, 1997 another post mortem was done by Dr. A.K. Singh, Tutor Department of Forensic Medicines and Toxicology, Patna Medical College Hospital, Patna. In his report he recorded as follows:—

> *"Erosion of the anterior surface of the 5th vertebra was noticed of 1/2" diameter. In view of the advise of the medical Board, (C.S. Chapra) for Skiagram X-ray of chest and abdomen, A.P. View was suggested which was done by the Radiology Dept. of P.M.H.C. Patna by a Portable X-ray machine, in the Mortuary. The report received from the radiology Dept. P.M.H.C. with two plates bearing No. - PM/365 dt. 20-3-1997 which read as such —chest A.P. — No evidence of radio opaque shadow seen. N.V. Longitudinal foreign body shadow seen in left side. Abdomen with pelvis view A.P. A Radio opeque shadow (F.B.) seen in L/5 level, left side, report was signed by Dr. (Mrs.) Aruna Jaiswal, Associate Professor, Dept. of Radiology, P.M.H.C. Patna.*

(2) The 5th Lumbar vertebra was opened and examined and a bullet was recovered from the body of vertebra which was kept in a glass vial properly levelled, sealed and handed over to constable No. 233 Dhaneshwar Yadav, P.S. Garkha with instruction to hand that over to the I.O. Immediately".

8.2 Motive for Causing Injury[1]

It has now to be seen whether conviction of two appellants namely Ghasita and Juhuru can be sustained or not? So far as appellant Ghasita is concerned, the allegation against him is that he opened fire at Hasmal which hit at his left leg. PW1 Hasmal, injured himself, has categorically deposed that it was appellant Ghasita who fired gun shot which hit on his left leg. PW2 Mst. Shesudan has also stated that appellant Ghasita opened fire, bullet of which hit on the leg of Hasmal. Similarly PW 3 Mst. Sharbati has also deposed that Ghasita opened fire which hit Hasmal. The statement of injured further finds corroboration by the statement of PW 4 Hatti PW5 Juhru who have deposed that Ghasita opened fire which hit on the left leg of Hasmal. The medical evidence further corroborates

1. *Ghasita* v. *State of Rajasthan*, 2006 Cr LJ 2408 (Raj).

the evidence of injured. To be more specific, it would be profitable to quote the injury report, Ex. P 5, which reads as under:

> "Oval shaped lacerated wound, blackening and churning and inverted margins surrounded by blackened area 2" x 1 -3/4" with bleeding on the back and outer surface and lower part of the left leg 2½" above and back from the lateral malleolus of left leg. It is an wound of entry ½ x ½" in size x deep up to wow of exit 3/¼" deep. The direction of the wound is upwards towards front and medial side straight and slightly upwards.
>
> Lacerated wound 3½" x 2¼" on the front and medial surface and lower part of the left leg 1½" above from medial malleolus of the left leg and the wound is deep up to the wow of entry. It is an wound of exit with profuse bleeding with multiple pieces of both bones of left leg at the site of injury with laceration of the muscles with everted margins of the wow of exit."

The injury has been stated to be grievous in nature. PW 7 Dr. P.L. Bansal who examined the injured has also deposed that this injury was grievous. PW 6 Dr. P.P. Singhal, Radiologist found fracture of lower 1/3rd of tibia and fibula and the report is Ex. P.3 and X-ray plate is Ex. P 4. It is thus established that appellant Ghasita caused firearm injury on the left leg of injured Hasmal.

There is no evidence that the injury on the person of injured was sufficient to cause death of injured. Further, there is no allegation against appellant Ghasita that he repeated the gun fire, for which he had an ample opportunity.

The only evidence against appellant is that he aimed gunshot only at the leg of injured, which resulted in fracture. In this view of the evidence it cannot be said that appellant Ghasita intended to cause death of injured or to cause such bodily injuries which may be sufficient to cause his death in the ordinary course of nature, so as to bring the offence within the purview of section 307 1PC. Thus considering the part of body at which the gun shot was fired and taking in view the fact that appellant did not repeat the shots, as also the fact that he fired gun shot at the leg and caused fracture, it must, be held that appellant Ghasita voluntarily caused grievous hurt by dangerous weapon viz., the gun and hence he must be held liable for committing offence under section 326 IPC.

8.3 Eyewitness Accounts *v.* Scientific evidence[1]

The contention on which considerable emphasis has been laid by the learned counsel for not believing the eye-witnesses is that their evidence is in conflict with the medical evidence. We shall, therefore advert to the medical evidence at this stage. PW/12 has deposed that he found the following injuries on the dead body of the deceased Gamu:

1. Gunshot wound (wound of entry) 2" x 1", lung deep, in left infra clavicular region, 1¼" lateral to left sternoclavicular joint, charring of margins of wounds, margins inverted, wound directed downwards, backwards, and laterally.
2. Gunshot wound (wound of exit) 3½" x 1¼", lung deep, middle of left side of the back, 2" lateral to midline at the level of the lower part of the scapula.
3. Lacerated wound 1/4" x 1/4" muscle deep, 2" above the wound No. 2.

1. *Hussain Khan* v. *State of Rajasthan*, 1976 Cr LJ 821.

On opening the dead body, it was further found that the 1st and 2nd ribs on the left side were fractured on the anterior side (front) and 5th, 6th and 7th ribs were fractured posteriorly (back). Pleura was ruptured at two places. Fluid blood was present on the left side, about 400 ml. A lacerated wound 2" x 2" through and through in the upper half of the left lung was found and the lungs were collapsed. Left pulmonary vessels were ruptured. The injuries, according to the doctor, were sufficient in the ordinary course of nature to cause death. He recovered 15 pellets from the dead body at the time of post-mortem examination. Out of these pellets, 12 were of small size and three were of big size and a few of them were lying loose in the wounds of the back and others were removed by dissection of skin around the wound on the neck. All were situated within an area of a circle of about 3" diameter from the centre of the wound on the back. In the wound of back, amongst the pellets, a few were of small size and bigger sized ones were also lying there. The edges of injury No 3 were inverted and irregular. The learned counsel has laid great emphasis on the following portion of the statement of PW. 12.

"On the post-mortem appearance I am of the opinion that the wounds were caused most probably by one shot. But I cannot say definitely because of the fact that the pellets were of two different sizes and I am not expert about the pellets" ..... "The edges of injury No. 3 were everted and irregular. The edges of injury No. 2 were also everted and irregular. The margins of injury No. 1 were regular and oval shaped and inverted. It is correct that on the body of deceased Gamu there was only one entry of gunshot wound and of that entry there were two exit wounds. Injury No. 3, the exit wound, was probably due to exit of two pellets. The wound of entry and the exit wound were through and through....."

> ***"There was no scorching or tattooing around the wound No. 1. The distance of the firearm must have been between 1 to 3 feet from the victim".***

There is a three-pronged attack of the learned counsel. His contention is that according to the direct evidence there were two fires which hit the deceased, whereas according to the medical evidence there was only one entry wound and two exits. Therefore, the direct evidence is belied.

Another branch of his argument in this connection is that the gunshot wound in the chest of the deceased caused a big hole which must have resulted in profuse bleeding, but no blood was found from the hut in which the first shout is said to have been fired upto the place where the deceased fell dead on account of the second gunshot in the back.

The third branch of his argument is that no wads and pellets were found inside the hut.

8.4 Identification of Injuries[1]

The trial court seems to have overlooked this statement and confined itself to the less specific statement of Ajit Singh given at the trial. The fact remains

1. *Bhoor Singh* v. *State of Punjab,* 1974 Cr LJ 929: AIR 1974 SC 1256.

that at the earliest, in the committal court, the appellant clearly alleged that Baldev Singh had been killed with a *sua* by the complainant party. This version was put to Dr. H.C. Gupta, who had performed the autopsy of Baldev Singh, in cross-examination, even in the committal court. The doctor replied that he could not rule out the possibility of these injuries having been caused with a *sua*. This opinion was not discussed by the trial court. The learned judges of the High Court also did not advert to it. Although in examination-in-chief, the doctor had said that these injuries were 'likely to be caused by a firearm', the circumstances on record definitely point towards the conclusion that the injury was probably caused with a sharp-pointed weapon and not with a gun. The injuries were triangular. The dimensions as noted by the doctor were:

(i) 3/4" x 1/2" x 3/4" on the front of the neck in the mid-line about 1½" below the chin;

(ii) Lacerated wound 1" x 1/2" x 1/3" on the back of the neck about 1" below the hair line.

A gunshot wound of entry caused by a single pellet or ball is ordinarily circular or oval in shape. If these injuries were the result of a gunshot fired from close range, with all the pellets piercing *en masse* through the neck, there should have been scorching, blackening and tattooing in and around the wound of entry. The wadding, or round cardboard pieces or pellets should have been found inside or outside the wound near the body. Nothing of this kind was found. Furthermore, the very story of Ajit Singh firing at Isher Singh, but instead hitting his own brother was improbable. According to the prosecution, Isher Singh was then interlocked in a struggle with Baldev Singh. If that was so, there should have been some gunshot injury on Isher Singh. But the doctor did not find any such injury on him.

The above negative and positive circumstances are telltale. Taken in conjunction with the doctor's opinion given in cross-examination, they probabilise the defence version that the injuries to Baldev Singh were caused with a sharp pointed weapon—and not with a firearm—by the complainant party.

We have, therefore, no hesitation in holding that the learned judges of the High Court were in error in upholding the conviction of the appellants for the murder of Baldev Singh, merely, on the basis, of what they termed "plausible explanation" rather than positive and convicting proof given by the prosecution. We would therefore, set aside that conviction.

8.5 Entrance or Exit Wound?[1]

Now we advert to the argument that the nature of injuries disclosed that the shot was fired while the injured was running and hit him from the back. It is mainly based on the medical evidence of first examining Dr. R.K. Mishra (P.W. 23) and the death summary Ex. P/38. In these, gluteal wound is mentioned as the entry wound. The Doctor has not given any reason for this opinion, but, the observation appears, *prima facie*, contradictory to medical opinion expressed by eminent Doctors or experts in their text-books of Medical jurisprudence. The gluteal wound was larger in size, *i.e.*, 1" x 1" and had everted margin.

1. *Vijay Singh* v. *State of Madhya Pradesh,* 2000 Cr LJ 650.

The wound at the root of scrotum was smaller in size *i.e.* $^{3}/_{4}$" x $^{1}/_{2}$" and had inverted margins. The area of injury to the muscle surrounding the scrotum for $3^{1}/_{2}$", is of no importance as the skin and muscle in that area are in, more or less, loosely hanging state in a man. So the real size of the wound would be the spot where the stiff muscle starts. The size of which was $^{3}/_{4}$" x $^{1}/_{2}$" with inverted margin. A wound of entry is smaller in size than the wound of emergence. The wound of entry has inverted margins and wound of emergence has everted margins. In *Modi's Medical Jurisprudence and Toxicology, Twenty first Edition at page 264* this opinion is mentioned: "The wound of entrance in distance shot is usually smaller than the projectile due to the elasticity of the skin, and round when the projectile strikes the body at a right angle and oval when it strikes the body obliquely. The edges of wound are inverted..... The wound of entrance and its edges are irregular and everted ..... The edges of both the wounds of entrance and exit may be everted in fatty persons due to protrusion of fat in the wounds, and in decomposed bodies from the expansive action of the gases of putrefaction.....". In a book on the subject namely: "Forensic Science in Criminal Investigation and Trials" by Dr. B.R. Sharma, Ph.D., Director, Himachal State Forensic Science Laboratory, Shimla, at page 275, it is observed regarding wounds caused by firearm that when velocity of a fired shot exceeds 600 meter per second and up to 1100 meter per second, it also causes wound of the nature of blast effect. Thus, the wound in the loose skin around the testicles of the deceased could be because of such effect also. At the same page it is also mentioned that if a projectile comes out of the body the exit wound is larger than the entrance wound. So the laceration in that area after testicles of the size $3^{1}/_{2}$ x 3" with irregular margin is explainable on this theory of blast effect of a fired shot. Even in Gaur's book namely *Fire Arms, Forensic, Ballistic, Forensic Chemistry and Criminal Jurisprudence (2nd Edition, 1989)* it is observed at page 82 that wound of exit is usually larger than the wound of entrance, unless on the way through the body the projectile is intercepted by some bones and, there is some deformity or disintegration in the projectile. Shri K. Kumar in his book "*Forensic Ballistics in Criminal Justice*" based on his experience as Directors of Ballistics Laboratory of various States, making a scientific exposition of gunshot wounds, compares wound of entrance and wound of exit as under:

Wound of Entrance	Wound of Exit
1. Size: Appears smaller than the wound of exit due to inversion. Greater the distance, smaller the appearance. Contact shots are exception to this phenomena due to stretching of surface skin.	Appears larger than the wound of entrance due to eversion. May appear smaller than the entrance if the entrance wound is a contact shot.
2. Shape: Regular, *i.e.* circular when the bullet hits at right angles and oval when it hits and penetrates in an angular direction.	The shape is of irregular size.

3. Nature: Punctured and lacerated.	May at times appear as incised particularly with high velocity, tapered and pencil point bullet.
4. Margins: Usually inverted, but in case of wound on fatty part of the body, the entrance wound may appear as everted due to protusion of fat. May be surrounded with abraded collar and contused. A quantity of grease may be deposited. There may be blackening, scorching, tattooing, singeing, of hair in case of close range shot. Microscopical examination of skin and subcutaneous tissues around the wound of entrance will disclose evidence of carbonisation, swelling and homogenisation of dermal collagen apart from the deposit of dark particles.	Usually everted, abraded collar, contusion, tattooing, blackening, burning, carbonsiation, etc., are absent.

These opinions in the eminent books on Medical jurisprudence cannot be ignored because of the opinion of the Doctor in this case, given without reason and without support of authority. Even if the Doctor was produced by the prosecution itself, the court is bound to see whether there is real conflict between the medical evidence and other evidence from the fact observed by the doctor. Thus, after having observed the size of the wounds and inverted and everted nature of the margins, the Doctor was required to give the opinion why he considers the gluteal wound as of entry. He has not done so. The opinion is contrary to the opinion of renowned experts. Similarly on what basis the death summary relates the gluteal wound as entry wound is not known.

8.6 Dimensions of Injuries[1]

We reserve for the end of this chapter a clinching piece of evidence which establishes that Tahsildar did not shoot Dudh Nath, inasmuch as we shall show in what follows that the latter was shot with a bullet fired from a .303 bore rifle and not a .500 bore rifle, the only weapon attributed to Tahsildar by the prosecution witnesses. What we call the clinching piece of evidence derives from the medical evidence with regard to Dudh Nath's injury.

This evidence discloses that the wound of entry of the bullet was in front of the abdomen and was 1/4" x 1/4" in size, while the wound of exit was on the back and was 1/3" x 1/3" in size. In the trial court no one paid any attention to the nature of the bullet causing an injury of these dimensions, and everyone seems to have assumed that it was in fact from a .500 bore rifle bullet. We considered this assumption of doubtful validity, hence we heard learned counsel specifically on the point and also consulted Taylor's Medical Jurisprudence and Major Julian S. Hatcher's Fire-Arms Investigation, Identification and Evidence. Referring to high-velocity bullets Major Hatcher observes at page 202 of his book:

1. *Tahsildar Singh* v. *State of Uttar Pradesh*, 1958 Cr LJ 424: AIR 1958 All 255.

The skin wound of entrance always corresponds in size to the diameter of the bullet used. It is very common for the aperture of entrance to appear smaller than the diameter of the bullet but this is an illusion, since the wound invariably admits a projectile similar to the one which caused it. The small appearance is due to elasticity and shrinkage of the skin.

It is also a fact that the wound of exit is usually larger than the wound of entrance. But no authority has been cited before us which could suggest that, unlike a wound of entry, the wound of exit can be smaller than the size of the bullet which causes it. During the hearing of the appeal we invited the learned state counsel to produce an expert before us who might give such an opinion, but he was unable to produce one.

Bullets of both .500 and .303 bores were produced before us, and by measurement we found that a .500 bore bullet has a diameter of exactly half-an-inch, while that of a .303 bore bullet is slightly less than one-third of an inch. These measurements, coupled with the expert opinion contained in the above mentioned standard work, leave no room for doubt in our mind that:

Dudh Nath's injury was caused by a .303 bullet and not by a .500 bullet, and we should like to point out that we are strongly of opinion that if the prosecution case that Tahsildar fired the rifle Ex. 1, which is of .500 bore, were true, Dudh Nath's entry and exit wounds would have been larger than that found by the medical officer. In point of fact, the wounds which were actually found by the medical officer are typically those caused by a .303 bullet.

This finding would exculpate the appellant of Dudh Nath's murder. Incidentally, for the benefit of subordinate courts we should like to point out that where a particular weapon is stated to be responsible for a certain injury, the witness should be asked to explain whether or not that weapon could cause the injury in question. In the instant case the omission to do this with regard to the injury of Dudh Nath and Karna has led to unnecessary difficulty.

8.7 Unusual Injuries[1]

According to the prosecution case Swaran Kaur, the aunt of the appellant, was standing behind Dial Singh when the appellant shot at him and the shot which entered the body of Dial Singh came out and hit Swaran Kaur. The prosecution evidence itself is that Swaran Kaur was trying to dissuade the appellant and his people from quarrelling. Therefore, she must have been in front of him and could not have been behind Dial Singh. Moreover, even according to the prosecution evidence she was at least 25 or 30 feet behind Dial Singh when the shot was fired by the appellant. A third circumstance is that whereas the injuries on the deceased were in the chest the injuries on Swaran Kaur were a little above the knee and below the knee. These three circumstances improbablise the prosecution story of the shot fired at Dial Singh going through his body and then going further and hitting Swaran Kaur, femur being fractured. The rib of the deceased was also fractured. In this state of the evidence the learned judges of the High Court thought it necessary to examine

1. *Mohan Singh* v. *State of Punjab*, 1975 Cr LJ 1865 (SC).

a ballistics expert. They have relied heavily on his evidence in order to sustain the conviction of the appellant. We have carefully gone through his evidence and are of the opinion that it does not help to establish the prosecution case, at least not beyond reasonable doubt.

According to the expert the parcel, Ex. P-1, contained two shots and the parcel P-2 contained one shot. The shots in parcel P-1 weighed 4.41 gms. and 4.24 gms. The correct weight of L.G. and S.G. shots is 4.54 gms and 3.54 gms. respectively. Therefore, the two shots in parcel Ex. P-1 were discharged from a cartridge of L.G. size. This part of the evidence may be accepted as correct even though there is some difference between 4.54 gms., 4.41 gms. and 4.24 gms. The shot contained in parcel EX. P-2 was found to weigh 2.76 gms. It could, therefore, be either an L.G or S.G. shot. The expert, however, says that the general shape of the undamaged portion indicated that the shot was possibly an L.G. shot. He was not categorical about it. He was sure that it was a factory made one. There are 6 and 9 shots in L.G. and an S.G. cartridge of standard size respectively.

Now in this case there were five injuries on the deceased all caused by shots. There were three injuries on Swaran Kaur. Even assuming that all these three injuries were caused by three injuries of the shots which entered Dial Singh's body, a position which we find it difficult to accept as natural in view of the force with which they have entered Swaran Kaur's body, there were two more shots, one found in the wall of Sardul Singh's house and another found in front of Malagar Singh's house. There are thus seven shots the presence of which has to be explained. The learned judges of the High Court thought that the shot found in front of Malagar Singh's house could have dropped from the person of Dial Singh when he was moving in the house of Malagar Singh or dropped from his apparel in which it had got caught after piercing through a wound. This is a proposition which appears to us to be far fetched. There is no evidence to support such a proposition. The expert was not asked about it, nor was the doctor who conducted the post-mortem. It appears to us that the shots which could pierce through a body and hit another person at a distance of 30 feet and cause grievous injuries to that person cannot drop from the body of the first person or get caught in his apparel after piercing through his wounds. It also appeals to us that the shots which passed through the body of Dial Singh could not have travelled another 30 feet and hit Swaran Kaur with such force as to fracture her femur. Furthermore, the location of the injuries on the body of Swaran Kaur compared to the location of the injuries on the body of the deceased person cannot be explained as easily as was thought possible by the learned judges of the High Court. The expert stated that the shots after entering the body of Dial Singh, had deflected downwards and this was particularly true in the case of injury number one; secondly, that Dial Singh must have instinctively ducked while receiving the shots at the instants when the shots came out of his body. It is not possible to accept that all the three shots which entered Swaran Kaur could have deflected downwards. If Dial Singh had also ducked then the shot which was deflected could have gone still lower and could not have hit her at all. The evidence of Joginder Kaur that immediately after the gunfire the deceased was seen in a bending position and staggering with his hand placed

on his wound cannot support this conclusion. A gunshot takes much less than a split-second to enter a body and we are unable to agree that Dial Singh could have ducked and that might have been responsible for the shots which entered his body finding a lower target when they came out of his body.

The expert stated that he came to the conclusion that the injuries on Dial Singh and Swaran Kaur were probably caused by one gunfire only. It must first of all be noted that he is not categorical about it. The reasons for his conclusion are the dimensions of the injuries. He had not seen the injuries and it would need superhuman ability to come to a conclusion on this subject by merely looking at the description of the injuries or even the photographs given by the doctors. The dimensions of the injuries noted by the doctors cannot be correct to the extent of 1/100th of an inch. Most of the expert's answers are not categorical. He did not have an opportunity of seeing the injuries of the shots himself. He was mostly giving his answers on the basis of observations made by others and measurements noted by them. A small difference in the measurements one way or the other might make all the difference to the final result.

We think it would be unsafe to place implicit reliance on the evidence of the expert for the reasons we have already given and hold that the shots which hit Swaran Kaur and which resulted in the death of Dial Singh were fired from the same gun in a single shot.

8.8 Injury—Firearm Linkage[1]

A faint attempt was made by Mr. Ray that the prosecution has failed to establish that the gunshot injuries on the deceased were from the gun (M.O. II).

The contention is frivolous and was rightly abandoned later on. It is the common case of the parties that there was only one gun at the time of occurrence and that gun belonged to and was held by accused No. 1 on the spot. The finding being that the deceased died as a result of gunshot injuries, it was not necessary for the prosecution to further establish that the injuries caused by gunshot were from the gun (M.O. II). The conclusion that the gunshot was through M.O. II is irresistible on the common case of the parties and no further proof is necessary as is required in some cases of gunshots.

8.9 Rifle Injury[2]

The learned Sessions Judge appears to have disbelieved the prosecution case mainly on the ground that the ocular evidence was inconsistent with the medical evidence, in that, according to the evidence of Dr. Paramjit Singh, Injury No. 11 could not have been caused by a firearm. In giving this finding the learned Sessions Judge completely overlooked the fact that a substantial number of injuries being incised and punctured wounds were fully supported by Dr. Jatinder Singh and not contradicted by Dr. Paramjit Singh. It was not, therefore, a case of the evidence being totally inconsistent with the medical evidence but a case where there was some doubt as to whether or not injury No. 11 was caused

1. *Paramananda Mahakud* v. *State of Orissa*, 1970 Cr LJ 931.
2. *Piara Singh* v. *State of Punjab*, 1977 Cr LJ 1941 (SC).

by a rifle. Here also two experts were examined one of whom had undoubtedly supported the prosecution case and categorically stated that injury No. 11 could have been caused by a rifle. Injury No. 11 is described in the evidence of doctor thus:

> ***"Irregular wound with inverted margin 2" X 1½" was on the left middle inguinal region with counter wound 4" X 3" on the back left buttock crease. Fractured femur and lacerated muscles were seen at the depth of the wound. Further dissection showed injury to the femoral vessels of the leg".***

The nature, position and content of this injury clearly shows that it was a firearm injury which could have been inflicted by a rifle. There was a wound of entrance and another of exit which could be only possible if the deceased was injured by a bullet.

There is the positive evidence of P.Ws. 3, 5 and 6 that Piara Singh had shot the rifle which hit the deceased. The bullet was found at the spot and the rifle which was recovered from the possession of Piara Singh was sent to the Ballistics Expert within a very short interval. The Ballistics Expert was of the opinion that the empty found could be discharged from the rifle of the appellant, Piara Singh. These circumstances, therefore, speak volumes in support of the prosecution case. The learned Sessions Judge has overlooked the effect of these circumstances in relying on the testimony of Dr. Paramjit Singh alone.

It is well settled that the positive evidence in the case is that of the eye-witness who had seen and narrated the entire occurrence. The evidence of a medical man or an expert is merely an opinion which lends corroboration to the direct evidence in the case. Where there is a glaring inconsistency between direct evidence and the medical in respect of the entire prosecution story, that is undoubtedly a manifest defect in the prosecution case.

This, however, is not the position here. There is no inconsistency between the direct and the medical evidence. What has happened is that two experts, namely, Dr. Jatinder Singh and Dr. Paramjit Singh had differed in their opinions. The High Court rightly observed that in view of difference of opinion between the two experts of the evidence of Dr. Jatinder Singh must be preferred as it is supported by the evidence of the eye-witnesses whose evidence is both reliable and trustworthy and is also supported by other circumstances proved in the case.

8.10 Self-defence Plea through Fake Injuries[1]

We have given our anxious consideration to the submissions of the counsel for the appellant but find ourselves unable to accede to the same. Two inextricably linked up questions that fall for consideration in this case in view of the stand of the appellant are whether the two injuries, *viz*; (1) Lacerated wound 1 x .5 cm. x, muscle deep, on medial side of left thigh in its middle with inverted margins but without any scorching, tattooing or blackening and (2) Lacerated wound .75 x .25 muscle deep on the middle and back of the left thigh, inner side with everted margins but without any scorching, tattooing or blackening

1. *Salim Zia* v. *State of Uttar Pradesh,* 1979 Cr LJ 951: AIR 1979 SC 391.

stated by D.W. 1 medical officer, Bilaspur dispensary, to have been observed by him on the person of the appellant at 6.00 p.m. on November 11, 1969 were caused as a result of shots fired from the revolver, Ex. 4, in the course of the same occurrence which resulted in the death of the deceased and whether the appellant was protected by the right of private defence of person or property.

In regard to the first question, the High Court has, after careful scrutiny of the depositions of D.W. 1, and chief medical officer, Lucknow, who is examined as an expert under section 391 of the Code of Criminal Procedure, came to the conclusion that the above noted injuries were not gunshot injuries and could not be caused with the revolver, Ex. 4, and were fabricated to look like gunshot wounds for the purpose of creating a defence. It has rightly been pointed out that there is no mention in the injury report (Ex. *Kha.* II) prepared by Dr. Verma after examination of the person of the appellant that the said injuries were through and through or communicating wounds and that since Dr. Verma admittedly did not try to ascertain by use of probe whether they were communicating injuries or not, he could not be expected to give a categoric opinion about their character merely on the basis of the condition of their margins or edges. The High Court has also correctly pointed out that the aforesaid injuries on the person of the appellant were not gunshot wounds as usually the entrance wound in firearm injuries is smaller and the exit wound is bigger but curiously enough this was not the case here. The High Court has also rightly found that aforesaid injuries on the person of the appellant could not be gunshot wounds as the exit wound was not only smaller in dimension than the size of the cartridge. Ex. 7, taken out of the revolver, Ex. 4, which according to the appellant was used by the deceased for causing injuries on his person. The observations of the High Court receive ample confirmation from the statement of court witness which appears to have been based on his personal experience and notable works of medical jurisprudence and toxicology by celebrated authors like Sydney Smith, John Glaister, Taylor and others, that in cases of a bullet injury, except where the bullet gets fragmented after entering the body and only a portion thereof passes out of the exit wound or the bullet remains embedded in the body and does not pass out in the normal course and is subsequently taken out or except in case of a point-blank wound (which is not the case of the defence), it is practically and usually not possible that the size of the wound of exit may be smaller than the diameter of the bullet. On being shown the aforesaid bullet, Ex. 7, Dr. Joshi stated that if the diameter of the bullet is 0.8 cm., it will not usually cause the exit wound described as injury No. 2 in Ex. Kha. III unless the bullet got fragmented inside the body or only a small piece, thereof, pierced and made the exit wound. Dr. Joshi has also expressly stated that considering the data as given in Ex. Kha. II it is doubtful that the aforesaid two injuries claimed by DWI to have been observed by him on the person of the appellant were bullet injuries. Thus the forensic medicine expert evidence in respect of the characteristics of the wounds said to have been observed on the person of the appellant rules out the case of the infliction of the injuries on the person of the appellant by the revolver, Ex. 4.

That these injuries were caused in the course of the same incident which resulted in the death of the deceased also seems to be highly improbable in

view of the statement of Narayan Singh Negi, investigating officer, who reached the scene of occurrence within an hour of the lodging of the report (Ex. Kha. 1) that he did not even on search find any blood at any place except in front of or underneath the body of the deceased.

This takes us to the consideration of the other crucial question *viz*, whether the appellant was protected by the right of private defence of person or property. It is true that the burden on an accused person to establish the plea of self-defence is not as onerous as the one which lies on the prosecution and that while the prosecution is required to prove its case beyond reasonable doubt, the accused need not establish the plea to the hilt and may discharge his onus by establishing a mere preponderance of probabilities either by laying basis for that plea in the cross-examination of prosecution witnesses or by adducing defence evidence. *Partap* v. *State of Uttar Pradesh*, AIR 1976 SC 1966.*

In the instant case, however, the appellant has not discharged that burden either by adducing any defence evidence or by eliciting from the prosecution witnesses the existence of facts and circumstances satisfying the requisite test of preponderance of probabilities entitling him to exercise the right of private defence either of person or of property.

It is, therefore, crystal clear that the Sessions Judge grossly erred in assuming that the appellant was fired at by Habib and that it was in exercise of the right of private defence that he in turn fired at Habib to save his own life.

8.11 Bleeding Injuries[1]

In this connection, the learned counsel has laid much emphasis on the fact that no blood marks were found either in the hut, where the first shot is alleged to have been fired, nor outside the hut upto the place where the victim fell after the alleged second shot. The learned counsel has argued that looking at the size of the wound caused by the first shot, there must have been profuse bleeding and some blood must have fallen on the ground. But since there is no evidence that there was any blood either in the hut or on the way, the direct evidence is false. In our opinion, the argument, though it appears attractive, has no substance. We have it in the evidence that due to winter season the deceased was putting on a shirt and a woollen coat. Further, he had pressed the wound while running, with both of his hands. The clothes of the victim were found soaked with blood and it is quite possible that no such quantity of blood may have fallen either in the hut or on the way as may be collected for the purpose of investigation. A lot of blood spread out at the place where the victim fell. It is also possible that the man might have bled internally after receiving the first gunshot wound. Thus, in our opinion, absence of blood marks in the hut or on the way is sufficiently explained.

8.12 Injuries on two Persons: from One or Two Guns[2]?

7. On 14.3.1979, the deceased, Shiv Charan P.W.1, Brij Raj Singh P.W.2, Yad Ram P.W.4, Nathi Lal (not examined) and Bishambhar (not examined) had taken the customary Gur (Jaggery) during the Holi festival.

1. *Hussain Khan* v. *State of Rajasthan,* 1976 Cr LJ 821.
2. *Ghurey Lal* v. *State of Uttar Pradesh,* (2008) 10 SCC 450.

8. On their way home, they happened to pass by the home of the accused. The accused was standing just outside his home and was holding a shot gun. The accused began to verbally abuse the deceased. Thereafter, the accused fired one single shot from his gun, killing the deceased with a bullet and causing injuries to Brij Raj Singh P.W. 2 with pellets. Hearing the gun shot, some people quickly assembled at the scene. The accused fled to his room, which he locked from inside. The uncle of the deceased, Shiv Charan, lodged the FIR that very evening, the 14th March, 1979 at 6.15 p.m., at the Barhan Police Station in the District of Agra.

9. The accused provided his own version of the event. According to the statement of the accused under section 313 of the Code of Criminal Procedure, he went to the place of Kanchan Singh where Gur (Jaggery) was being distributed. One Bal Mukand told the accused to leave the Gur distribution ceremony, as the deceased, Brij Raj Singh P.W. 2, Yad Ram P.W.4, Nathi Lal and Bishambhar had collectedpharsa, lathis and kattas declaring that they will deal with him (accused) when he comes there. On hearing this, the accused returned to his home and grabbed his gun. The deceased and others then arrived at his home, brandishing weapons. The deceased carried a pharsa, Nathi Lal had a katta, Brij Raj Singh a knife and Yad Ram and Bishambhar possessed lathis. To threaten and check them, the accused aimed his gun at them. This was to no avail. The deceased and others struck at the accused, hitting his gun. Nathi Lal fired his katta, causing pellet injuries to Brij Raj Singh P.W.2. A scuffle ensued in which the deceased's group tried to snatch away his gun. In the scuffle, the gun was accidentally fired, killing the deceased. The accused sustained pharsa and lathi blows on the butt and barrel of the gun. Fearing for his life, the accused went to his room and locked the door from inside.

10. Brij Raj Singh P.W. 2 was sent to the Government Hospital, Barhan for medical examination. Dr. Govind Prasad P.W. 3 found the following injuries on the person of Brij Raj Singh, P.W. 2:

1. Round lacerated wound 0.3 cm x 0.3 cm on right side back 10 cms away from mid line 9 cms below border of scapula. Margins burnt and inverted, and tattooing present in an area of 5 cms. No pellets alpable. Bleeding present.
2. Lacerated wound of exit 1.5 cm x 0.5 cm on right side back 0.8 cm away and lateral from injury no. 1. Skin burnt and tattooing present in the area of 5 cm x 5 cms. Merging of the wound inverted. No pellets palpable.

11. The Doctor opined that the injuries were caused by a firearm. He advised that x-rays be taken and that the injuries be kept in observation. In his opinion, the injuries were caused by a gunshot and were of fresh duration. In his opinion, the injuries could have been caused around 4 p.m. The doctor sent the memo Ex. Ka-4 on the same day, informing the case of Medico legal nature to the Barhan Police Station.

12. The autopsy on the deceased was conducted by Dr. Ram Kumar Gupta, P.W.5, Medical officer, SNM Hospital, Firozabad, District Agra. It revealed the following ante-mortem injuries on the deceased:

(1) Gunshot wound of entry 2.5 cm x 2.5 cm x through and through on right side neck 2 cm lateral to midline of neck front aspect.

(2) Gunshot wound of exit 5 cm x 4 cm x through and through on right side back of neck 5 cm below right ear corresponding to injury no. 1 with margins everted.

The Doctor opined that the cause of death was due to shock and hemorrhage as a result of ante-mortem injury.

* * * * *

15. The crucial question which arose for consideration was whether the injuries caused to Brij Raj Singh P.W.2 could have been caused by the same shot that killed the deceased. If that was possible, the prosecution version became probable. But if the shot that killed the deceased and the shot that caused injuries to Brij Raj Singh were from different weapons, then the defence version was more probable.

Shri B. Rai, Ballistic Expert, Forensic Science Laboratory, U.P. was called as court witness No. 1. He was asked to explain the nature of the 12 bore cartridges and give an opinion, for which he wanted time to carry out experiments in the laboratory. The gun was given to him and he performed a test in his laboratory in the light of the statements of the eye-witnesses, medical report and site-plan. He submitted his report, Ex. C- Ka.1, wherein he clearly opined that injuries Nos. 1 and 2 of the deceased were possible by the gun Ex.3 of the accused and injuries Nos.1 and 2 of the injured Brij Raj Singh were possible by another fire. By "fire", it is clear from the record that the Ballistic Expert was referring to a "firearm".

16. Ultimately, we must answer the following question:

Whether the prosecution story of a single shot causing injury to two persons, that is bullet injury to deceased and pellet injury to Brij Raj Singh, with the accused as the aggressor, stands sufficiently proved beyond reasonable doubt?

17. In order to decide whether a single shot was fired or in fact two different shots were fired, we must carefully examine the versions of the prosecution and the defence and the report of the Ballistic Expert. According to the trial court, the medical evidence coupled with the Ballistic Expert report revealed the existence of two fires from two weapons and as such was inconsistent with the prosecution story. The trial court further provided that it is difficult to separate falsehood from the truth, as some material aspects of the occurrence appeared to have been deliberately withheld. "One has to separate the chaff from the grain and it is difficult to lay hand upon what part of the prosecution evidence is true and what part is untrue". According to the accused, the trial court had taken a reasonable and possible view of the entire evidence on record.

18. The post-mortem report Ex. Ka-5, photo lash Ex. Ka-7 and the statement of Dr. Ram Kumar Gupta P.W.5 indicate that the wound of entry was on the right side of the neck 2 cm. lateral middle line on front aspect. The exit wound was on the right side back of neck 5 cm. below the right ear. This means that the bullet had entered from the front side of the neck from (*at?*) a distance of 2 cm. lateral to middle line, and it had come out from the back of the neck at

a place 5 cm. below the right ear. In this way, the trial court reasoned that the barrel of the gun, when discharging, was slanting vertical. The mouth of the barrel was upward and its butt downward. The barrel and the butt were not horizontal to the ground at that time.

19. The trial court observed that injury no. 1 (wound of entry) on Brij Raj Singh P.W.2 was on the right side of his back 10 cm. away from the mid line, 9 cms. below the lower border of scapula. Injury no. 2 (wound of exit) was on the right side of his back 8 cm. away and lateral from injury no.1. This means that the exit wound was by the side of the entry wound at a distance of 8 cm.

20. The dictionary meaning of 'lateral' is "by the side" and this means that the two injuries caused by pellets to Brij Raj Singh P.W.2 were horizontal and not vertical. The trial court opined that the single shot could not have caused vertical injury to one person and horizontal injury to another. It found it doubtful and not sufficiently proved that the same shot could have injured Brij Raj Singh and killed the deceased.

21. This conclusion is further fortified by the report of the Ballistic Expert Sri B. Rai court witness No.1. He has given a definite opinion after making actual experiments by firing shots. This was done from the distance at which the occurrence was said to have taken place. The eye-witnesses had testified to this distance. The Ballistic Expert opined that the injuries to Brij Raj Singh P.W.2 were from a different shot from the one that killed the deceased.

22. The relevant part of the evidence of the Ballistic Expert reads as under:

> **Question**- Whether bullet and Chharras both be used in 12 bore gun or not?
>
> **Ans.**- 12 bore gun have no bullet. It has small chharas, big chharas or one single ball shot with diameter about 0.645."

23. The Ballistic Expert after studying the post-mortem report observed as under:

> *"Studying the Post Mortem report No. 51/79 of deceased Ghurey Lal and injury report of Brijraj Singh dated 14.3.79, statement of doctor and witnesses and site plan and keeping the result of above experiments in mind, I reached in conclusion that injury No. 1 and 2 possible to sustain to deceased Ghurey Lal by this gun from the distance of 10 feet and injury No. 1 and 2 of injured Brij Raj Singh seems to sustain by some other shot."*

24. The Ballistic Expert categorically stated that in cartridges of standard 12 bore shot guns, bullets from other rifles cannot be used with small and big chharas (pellets). Therefore, the trial court concluded that both the injuries were not possible by a single firearm.

25. Leading experts of forensic science, particularly ballistic experts, do not indicate that from a single cartridge both bullets and pellets can be fired. Professor Apurba Nandy in his book "Principles of Forensic Medicine", first published in 1995 and reprinted in 2001, discussed cartridges. Professor Nandy mentioned that in some cases, instead of multiple pellets, a single shot or metallic ball, usually made of lead, is used. We note that the discussion regarding cartridges

exclusively mentions pellets. No mention of bullets and pellets in cartridges is found in the numerous volumes of scholarly literature that we have consulted. Relevant discussion reads as under: p. 241

"The Cartridges (the ammunitions)—

'The cartridge of a shotgun and the cartridge of a rifled weapon are essentially different in their Makes. The cartridge of a shot gun - (Fig. 10.69) The cartridge of a shotgun- has the following parts and contents—

1. The cartridge case - The longer anterior part of the cartridge case is made of card board. The posterior part and the posterior surface is made of brass. The margin of the breach end of the cartridge case is rimmed, so that, the cartridge can be properly placed inside the chamber and with pressure on the rim the empty cartridge case can be easily ejected out of the chamber. The anterior margin of the cartridge case is twisted inward to keep the pellets and other materials inside the case compact. The anterior part of the cartridge case is made of cardboard, for which, with production of gas inside the cartridge case it can slightly expand so that, the twisted grip by the anterior margin will be released and the pellets can come out of the case. The posterior metallic part keeps the shape of the breach end of the cartridge intact. It helps to maintain the right position of the cartridge in the chamber, so that, the percussion pin of the hammer strikes the percussion cap rightly at the breach surface of the cartridge. At the central part at the breach end inside the cartridge case is the percussion cap.
2. The percussion cap - It contains primer or priming mixture and there are some vents or openings on the wall of the percussion cap. When the posterior surface of the percussion cap is struck by the percussion pin, the priming mixture which consists of a mixture either of mercury fulminate, pot. chlorate and antimony sulphide or of antimony sulphide with lead styphnate, lead peroxide, barium nitrate or tetracene, gets ignited due to the pressure and friction and fire comes out through the vents or openings on the wall of the percussion cap.
3. Contents inside the cartridge case. Surrounding the percussion cap is the gun powder or the propellant charge which cannot ignite by pressure or friction and which on being ignited does not produce flame but produces huge amount of gas. Usually the gunpowder of the shotguns contains charcoal, pot, nitrate and sulphur. This combination of the gunpowder is known as black powder, as it produce much smoke. Now-a-days semi smokeless gun powder is in use in shot guns which is a combination of 80% of black powder and 20% of smokeless powder. Smokeless powder is ordinarily used in the cartridges of rifles (nitrocellulose or a combination of nitrocellulose and nitroglycerine). The black powder produces 200 - 300 ml. of gas per grain. In front of the gunpowder, inside the cartridge case, there is a thin cardboard disc. In front of the cardboard, disc is placed the wad. The wad is made of soft substance like, felt, cork, straw or rug. In front of the wad, there

is another card board disc. In front of this disc, the pellets are placed. The pellets are spherical projectiles used in shot guns. Their size may be variable, according to the need and make. One ounce of pellets may consist of 6 to 2,600 of them. In front of the pellets there is another cardboard disc on the anterior margin of which the anterior margin of the cartridge case is twisted. The functions of the wad are to give compactness to the gunpowder, to prevent admixture of propellant charge and the pellets and prevent leakage of the gas produced after the firing. Wad also cleans the inner surface of the barrel after the pellets pass out through the barrel. To facilitate this cleaning, some greasy material is soaked in the wad. In between the propellant charge and the wad there is a cardboard disc so that the greasy substance in the wad will not be soaked by the propellant charge and become useless. In between the wad and the pellets there is a disc which in one hand prevents impregnation of the pellets in the soft wad and on the other, prevents leakage of the greasy substance from the wad in the pellets which would otherwise become adhesive to each other losing their dispersion capacity. The anterior - most disc, placed in front of the pellets, give compactness to the pellets and the whole content of the cartridge case.

Shots of different sizes are suitable for different purposes. Accordingly "Buck shots" or "Bird shots" have different sized shots or pellets for hunting wild birds or other prey. In some cases instead of multiple pellets a single shot or metallic ball, usually made up of lead, is used. "Rifled slugs" are single shot projectiles for shotguns with prominent parallel grooves on the surface."

26. In this book, the assessment of the direction of firing from the margin of the wound of entrance has also been given, which reads thus: p. 257

"Assessment of the direction of firing from the margin of the wound of entrance—

(i) (a) In case of shotgun injury, the pattern of dispersion of the pellets give the direction of the firing. The pellets disperse over wider area as it travels more. Hence firing is suspected to have been from the side opposite to the side of wider dispersion of the pellets. ....."

27. ***"Firearms in Criminal Investigation and Trials"*** **was written by a distinguished professor Dr. B.R. Sharma.** He has written in some detail about 12 bore guns. This book also defines Pellet Pattern which reads thus: p. 204

"Pellet Pattern

The area covered (pellet spread) by the pellets fired from a shotgun is proportional to the distance between the muzzle of the firearm and the target. Greater the range, greater is the area covered by the pellets. The spread of the pellets is affected mainly by the length of the barrel of the firearm and its muzzle characteristics (whether it is choked or not). The condition of the ammunition also affects the results. If experiments are performed with the same firearm and ammunition of the same make and batch, the test patterns provide fairly accurate estimates of the range. Generally, the whole charge enters the body en masse up to a range

of about two metres in a factory-made 12-bore shotgun. It forms a rat-hole of about two to six centimetres in diameter. The rat-hole is surrounded by individual holes when the range of fire is about two to seven metres..."

28. The trial court stated that in the FIR itself it is mentioned that the injuries to Brij Raj Singh were by pellets and that of the deceased by a bullet. The Ballistic Expert has stated that the cartridge containing pellets cannot contain a bullet.

Accordingly, the trial court reasoned that two weapons were used.

29. The Ballistic Expert is a disinterested, independent witness who has technical knowledge and experience. It follows that the trial judge was fully justified in placing reliance on his report.

30. The trial court also observed that removing the body of the deceased from the place of occurrence creates doubt that the prosecution was planning to substitute another story for the real facts. As such, the possibility that the deceased and his group were the aggressors is not ruled out. It is possible that pharsa and lathi blows had made the marks that were found on the gun. The gun may have snatched all of a sudden, causing it to fire upon the deceased and Brij Raj.

Under the circumstances of the case, the use of another weapon, which had caused injuries to Brij Raj Singh P.W.2, is also not ruled out.

31. The trial court further observed that the substratum of the prosecution story about the injuries to Brij Raj Singh is not established beyond reasonable doubt and the story of shooting the deceased by the same shot fired by the accused is not separable from other doubtful evidence of eye-witnesses. The circumstances show that the possibility of aggression on the part of the complainant side is not ruled out, then the benefit of doubt for killing the deceased by the accused would also go to the accused.

32. The trial court also found force in the plea of right of private defence as set up by the accused. The trial court mentioned that there is force in this argument where the circumstances of the case show that two firearms were used in the occurrence. The accused was all alone in his house at that time. The availability of a second weapon is possible only when the complainant side had brought it to the scene. This circumstance supports the defence case, that the complainants' side was the aggressor and they had come armed with weapons to the scene. It follows that the accused would apprehend grievous hurt and danger to his life. Accordingly, the right of self defence was open to him.

Main reasons for acquittal by the trial court:

38. The trial court acquitted the accused for the following reasons:

1. The prosecution story of single shot injury to two persons one standing horizontally and the other vertically stands totally discredited by the medical and the evidence of Ballistic Expert.
2. According to the FIR, the deceased received a pherical ball (ball shot) bullet injury and Brij Raj Singh P.W.2 received pellet injuries. The accused's gun had a cartridge that could only contain pellets. The Ballistic Expert has clearly stated that a cartridge containing pellets cannot contain a bullet. As such, it appears that two weapons were used.

3. Dr. Ram Kumar Gupta, P.W.5 who conducted the post-mortem of the deceased, clearly stated that the deceased received injuries from a bullet whereas Dr. Govind Prasad Bakara who had examined Brijraj Singh P.W.2 clearly stated that both injuries were caused by a pellet. Therefore, according to medical evidence coupled with the evidence of the Ballistic Expert, two firearms must have been used.

   This version is quite inconsistent with the prosecution story.
4. The injuries received by Brij Raj Singh P.W.2 were from the back side and the injury received by the deceased was from the front side and this shows that two weapons may have been used.
5. Removal of the body of the deceased from the place of occurrence also created doubt with regard to the veracity of the prosecution version.
6. The possibility that the deceased and the complainant's side were aggressors and had gone there and caused pharsa and lathi blows on the accused cannot be ruled out because of the marks on the gun Ex. 3. That the said gun was fired in snatching all of a sudden, injuring the deceased also cannot be ruled out from the circumstances of the case.
7. The trial court did not discard the defence version of right of private defence as pleaded by the accused.
8. The trial court observed that it is difficult to separate falsehood from the truth, where some material aspects of the occurrence seem to have been deliberately withheld. It is a well-established principle of criminal jurisprudence that when two possible and plausible explanations co-exist, the explanation favourable to the accused should be adopted.

Main reasons for reversal of acquittal order:

39. The High Court gave the following reasons for setting aside the acquittal:

1. A perusal of the post-mortem report goes to show that autopsy conducted on the dead body of the deceased revealed ante-mortem gunshot wound of entry 2.5 cm x through and through on right side neck 2 cm lateral to midline of neck front aspect having corresponding wound of exit 5 cm x 4 cm on right side back of neck 5 cmbelow right ear. Therefore, this injury was almost horizontal.
2. Medical examination of injured Brij Raj Singh revealed a round lacerated wound of entry 0.3 cm x 0.5 cm on right side back 10 cm away from midline and 9 cm below lower border of scapula having wound of exit 1.5 cm x 0.5 cm x 0.5 on right side back 0.8 cm away and lateral from injury no. 1. Thus, this injury was also almost horizontal.
3. The observation made by the trial judge that firearm injury caused to the deceased was vertical and to that of Brij Raj Singh horizontal is wholly fallacious.
4. A layman does not understand the distinction between a cartridge containing pellets and the bullet. In common parlance, particularly in villages when a person sustains injuries by gun shot, it is said that

he has received 'goli' injury. Ghurey Lal fired at his uncle with his gun causing him Goli (bullet) injury and Brij Raj Singh also received pellet (chhara) injury which goes to show that injuries received by them were caused by two different weapons. There is hardly any difference between bullet and pellet for a layman. From 12 bore gun cartridge is fired and 12 bore cartridge always contain pellets though size of pellets may be different.

5. A perusal of the post-mortem reports goes to show that autopsy conducted on the dead body of the deceased revealed ante-mortem gunshot wound of entry 2.5 cms. through and through on right side neck 2 cm lateral to midline of neck front aspect having corresponding wound of exit 5 cm x 4cm on right side back of neck 5 cm below right ear. Therefore, this injury was almost horizontal.
6. The medical examination of injured Brij Raj Singh revealed a round lacerated wound of entry 0.3 cm x 0.5 cm on right side back 10 cm away from midline and 9 cm below lower border of scapula having wound of exit 1.5 cm x 0.5 cm x 0.5 cm on right side back 0.8 cm away and lateral from injury no. 1. Thus, this injury was also almost horizontal.
7. The learned trial judge had noted the evidence of B. Rai, Ballistic Expert, C.W.1 that both the injuries would have been caused by two shots. While B. Rai, Ballistic Expert, C.W.1 had given the said opinion, he had also stated in his cross-examination by the prosecution that if the assailant fired from place 'C' and the person receiving pellet injury standing at place 'B' would have turned around, on dispersal of pellets he could have received the pellet injuries if deceased and injured both would have stood in the same line of firing.

Our conclusions:

40. We disagree with the High Court. Admittedly, the deceased died of a bullet injury whereas Brij Raj Singh, P.W. 2 received pellet injuries. It is well settled that a cartridge cannot contain pellet and bullet shots together. Therefore, the injuries on deceased and injured P.W. 2 clearly establish that two shots were fired from two different firearms.

In light of the above, the High Court and other appellate courts should follow the well settled principles crystallized by number of judgments if it is going to overrule or otherwise disturb the trial court's acquittal.

1. The appellate court may only overrule or otherwise disturb the trial court's acquittal if it has "very substantial and compelling reasons" for doing so. A number of instances arise in which the appellate court would have "very substantial and compelling reasons" to discard the trial court's decision. Very substantial and compelling reasons" exist when:

(i) The trial court's conclusion with regard to the facts is palpably wrong;

(ii) The trial court's decision was based on an erroneous view of law;

(iii) The trial court's judgment is likely to result in "grave miscarriage of justice";

(iv) The entire approach of the trial court in dealing with the evidence was patently illegal;

(v) The trial court's judgment was manifestly unjust and unreasonable;

(vi) The trial court has ignored the evidence or misread the material evidence or has ignored material documents like dying declarations/ report of the Ballistic expert, etc.

This list is intended to be illustrative, not exhaustive.

2. The Appellate Court must always give proper weight and consideration to the findings of the trial court.

3. If two reasonable views can be reached - one that leads to acquittal, the other to conviction – the High Courts/appellate courts must rule in favour of the accused.

78. On careful analysis of the entire evidence on record, we are of the view that the reasons given by the High Court for reversing the judgment of acquittal are unsustainable and contrary to settled principles of law. The trial court has the advantage of watching the demeanour of the witnesses who have given evidence; therefore, the appellate court should be slow to interfere with the decisions of the trial court. An acquittal by the trial court should not be interfered with unless it is totally perverse or wholly sustainable.

79. On consideration of the totality of the circumstances, the appeal filed by the appellant is allowed and the impugned judgment passed by the High Court is set aside. The appellant would be set at liberty forthwith unless required in any other case.

8.13 Nature of Firearm from Injuries[1]

3. On 4.4.1999 Rakesh Kumar Pandey along with his brother-in-law Surya Narain @ Vakil Shukla along with three others, Devi Shankar Dubey, Prem Shanker Dubey and the car driver Shesh Mani were returning from Aurai to Gopiganj in the latter[\022] s car No. WB 26A 7554. As the car reached near the Trimuhani on the middle of the road in Gopiganj, accused Udai Bhan Singh, Akbal Bahadur @ Atkoti Singh, Prem Singh, Dhunni Singh, Munni Singh, Daroga Singh, Rajeshwar Upadhyay, Pintoo Singh and two other persons all armed with modern weapons starting firing at the car. The firing led to the death of Surya Narain @ Vakil Shukla, Devi Shanker Dubey and Shesh Mani at the spot. Rakesh Kumar Pandey and Prem Shanker who were sitting on the rear seat rushed out of the car to save themselves and they too received some superficial injuries in that process. The assailants also picked up the licensed rifle of Prem Shanker Dubey which was lying in the car and thereafter ran away from the Spot.

The occurrence was also witnessed by Shiv Prasad @ Dangar Tewari, Mukand Lal, Ram Dutt Mishra and several other persons. A FIR was thereafter lodged by Rakesh Kumar Pandey at 3.45 p.m. in Police Station Gopiganj a kilometer away

1. *Sarvesh Narain Shukla* v. *Daroga Singh*, AIR 2008 SC 320.

from the place of incident, on which S.I. Vidya Prakash Misra reached the place of occurrence and recorded the statement of Rakesh Kumar Pandey whereas SI Rashid Ahmad prepared the inquest reports of the deceased on the dictation of SI Vidya Prakash Misra. On an inspection of the site, several pieces of glass, a blood stained piece of rexine, and shoes and some fired cartridges, a rifle and a 9 mm pistol licensed to deceased Surya Narain Shukla were recovered. The bodies were also sent for the post mortem examinations. The post mortem examination on the dead body of Devi Shanker Dubey was conducted by Dr. Radhey Raman on 4.4.1999 at about 11.55 p.m. whereas Dr. Sanjay Tewari conducted the post mortem examinations on the dead bodies of Shesh Mani at 11.30 p.m and that on Surya Narain Shukla 45 minutes later *i.e.* at 0030 hours. All three dead bodies showed extensive firearms injuries. Dr. A.K. Pandey also medically examined Prem Shanker Dubey at 5.25 p.m on 4.4.1999 and found two lacerated simple injuries on his person whereas the examination of Rakesh Kumar Pandey at 8.15 p.m. on 4.4.1999 by Dr. L.S. Mishra showed five simple injuries; three abrasions and two contusions. The doctors opined that these injuries could have been caused as the two were making a hurried exit from the car. On the completion of the investigation the accused were charged for offences punishable under sections 147, 148, 302 read with 149 I.P.C whereas appellant Suresh Singh @ Jajjey Singh was in addition charged under section 379 IPC for having taking away Prem Shankar Dubey\022s rifle from the car whereas Tehsildar Singh and Suresh Singh were further charged under section 411 I.P.C. The accused pleaded not guilty and sought trial.

* * * * *

13. Mr. Sushil Kumar has also laid great stress on what he perceives to be an apparent discordance between the ocular and the medical evidence. He has emphasized that the Investigating Officer had picked up three spent cases of a 12 bore shotgun from the spot and a wad had also been recovered from one of the dead bodies at the time of the post mortem examination thus indicating that only shotguns and no pistols or carbines as alleged had been used, which clearly falsified the eye witnesses. He has in this connection cited the judgment in *Awadhesh* v. *State of Madhya Pradesh,* (1988) 2 SCC 557 to submit that where medical opinion was at variance with the ocular account the accused were entitled to the resultant benefit.

Undoubtedly, the medical evidence is extremely relevant in testing the credibility of an eyewitness but we are of the opinion that the eye witness account is fully in consonance with the statements of the doctors and the other medical evidence. It has come in the statement of the eyewitnesses including Prem Shankar Dubey and also of Dr. Sanjay Tewari PW 8 on specific questions put to them that the shots had been fired from a distance of a foot or two.

We now reproduce the post mortem reports prepared by PW Dr. Sanjay Tewari with respect to Vakil Shukla and Shesh Mani Rai:

Vakil Shukla

2. Lacerated wound 2x1 Cm. on the mid forehead with charring and tattooing around it. Fontal bone not injured.

3. Abrasion 1x 0.5 Cm. on the mid forehead with charring and tattooing around it.

4. Wound of firearm entry 6 in number each measuring 0.8x0.8 Cm. on the top and back of the left shoulder. Margins of wound inverted with blackening and tattooing all around it with their wound of exit as follows—

(1) 1.5 x 1.5 Cm. on the left side chest below the left axilla 5 Cm. below the apex;

(2) 3 x 3 Cm. on the left side chest 8 Cm. below and lateral to the left nipple;

(3) 1x1 Cm. on the right side chest 6 Cm. below the right nipple.

(4) 1x1 Cm. on the right side chest 4.5 Cm. above and medial to the right nipple;

(5) 1x1 Cm. on the right side chest 8 Cm. below the right nipple; and

(6) 1x1 Cm. on the right side chest 6.5 Cm. lateral to the right nipple.

4. Firearm wound of entry 0.8x0.8 Cm. on the lateral surface of right mid thigh with inverted margins and tattooing all around it with its wound of exit on the medial surface of thigh at the same level with averted margins 1x1 Cm.

Shesh Mani Rai

(1) 5x4 Cm. on the right side neck 1 cm. below and posterior to the right ear. Margins of the wound were inverted with charring and tattooing of skin all around with its wound of exit of size 6x5 Cm. on the left side face/over and lateral to the left eye with averted margins;

(2) Wound of entrance 5.5x4 Cm. on the right side eye margin of the wound inverted with charring and tattooing of skin all around, with its wound of exit 6x6 Cm. below the left ear. Margin of the wound averted.

(3) Wound of entrance 1x1 Cm. on the lateral aspect of left arm. Margins of wound inverted with charring and tattooing of skin all around with its wound of exit 1.5x1.5 Cm. on the posterior lateral aspect of the left arm. Margins of wound Averted[\024].

14. Dr. Radhey Raman PW 3 recorded the following injuries on the dead body of Devi Shankar Dubey:

(1) Firearm wound of entry with charring and tattooing of size 2x1 Cm. It. Side of the chest just below the middle part of Lt. Clavicle. Lt. Side clavicle fractured with same wound of exit.

(2) Firearm wound of entry with charring and tattooing of six 1x1 Cm. on rt. Supra clavicle region 4 Cm. medial to top of rt. Shoulder, margins of wound inverted, with its wound of exit 2.5x2.00 Cm. on the lt. Side of chest on its lateral side 5.00 Cm. lateral and just below it. Nipple margin of wound of exist is averted; and

(3) Abraded contusion 2x2 Cm. on rt. Side of the forehead[\024.] [A cork (1.5 x 1.2 cm) was also recovered from the dead body.

15. Relying on the above quoted evidence it has been emphasized that there appeared to be no injuries from a rifle or pistol. We however beg to differ. It

bears reiteration that shots had been fired from a distance of a feet or two and this opinion is fortified as the entry wounds without exception show signs of charring and tattooing. The dimensions of the entry wounds also show that several different types of weapons have been used. It is clear from the post mortem examination of Devi Shankar Dubey\022s body (during which a cork had been recovered) that a shotgun had undoubtedly been used in his murder and that the shot had entered en masse as is apparent from the size of wound of entry (Injury No. 1).

16. We now come to the reports of the other two deceased. Injury No. 3 on the person of Vakil Shukla is clearly not an injury caused by a shotgun and has been caused by a medium calibre automatic or semi-automatic rifle or pistol. Mr. Sushil Kumar has however submitted that this injury had possibly been caused by a shotgun using buckshot SG/LG cartridges as had a high velocity rifle been used from a close range as suggested, the bullet would have had a blasting effect on the body. We, however, find that this argument is not substantiated on the evidence, that is, available to us. Undoubtedly, this shot too had been fired from a little beyond point blank range and if it had been fired from a shotgun, the shoulder would have been shattered and in any event the entire charge would have entered the body en masse making a rat hole wound of entry**.**

We are fortified in our view by the observations on page 465 of the Fourth Edition of Dr. B.R. Sharma….*Forensic Science in Criminal Investigation and Trials:*

> ***9.10.7.3 Shotgun injuries:***
>
> ***The nature of the injuries caused by the shotgun is greatly altered by the range. Contact or near contact wounds look like explosions. Close range shots up to about three meters give rat holes varying in diameter from about 2 to 6 centimetres. From about 2 metres to 10 metres the projectiles may form a rat hole surrounded by individual pellet holes. Beyond 10 metres most of the shots form separate holes. The buckshots may separate earlier. For example, an LG cartridge may give individual injuries for each shot from a range of about 2 metres.***
>
> ***The area covered by the pellets vary with the range and the choke characteristics of a gun. Ordinarily, the shotguns projectiles do not form exit holes except when buckshots are used from close range.***
>
> * * * * *

17. Modi: *Medical Jurisprudence and Toxicology,* Twenty-third Edition at page 722 is to the same effect. We reproduce the relevant passage hereunder:

> *The effects produced by small shot fired from a shotgun vary according to the distance of the weapon from the body, and choking device. A charge of small shot, fired very close to, or within a few inches, of the body enters in one mass like a single bullet making a large irregular wound with scorched and contused edges, and is followed by the gases of the discharge which greatly lacerate and rupture the deeper tissues. Particles of unburnt powder expelled from the weapon behind the missile are driven to some distance through the wound, and some of them are found embedded in the wound and the surrounding skin, which is also*

singed and blackened by the flame and smoke of combustion. The exit wound of a close range shot may show greater damage of tissues than the entrance wound, the margins are everted, but there is no evidence of blackening of singeing. At a distance of one to three feet, small shots make a single aperture with irregular and lacerated edges corresponding in size to the bore of the muzzle of the gun, as the shot enter as one mass, but are scattered after entering the wound and cause great damage to the internal tissues. The skin surrounding the wounds is blackened, scorched and tattooed, with unburnt grains of powder. On the other hand, at a distance of six feet, the central aperture is surrounded by separate openings in an area of about two inches in diameter made by a few pellets of the shot, which spread out before reaching the mark. The skin surrounding the aperture may not be blackened or scorched, but is tattooed to some extent. At a distance of 12 feet, the charge of the shot spreads widely and enters the body as individual pellets producing separate openings in an area of five to eight inches in diameter depending on the choke, but without causing blackening, scorching or tattooing of the surrounding skin.

18. Mr. Sushil Kumar argument with regard to the use of a high velocity rifle and its effect on the body when fired from a close range would undoubtedly merit serious consideration but in the light of the facts on the record, we are unable to concur. It is the case of the prosecution that carbines and 9 mm pistols in addition to shotguns had been used during the attack. A carbine, a high velocity weapon firing automatically or semi=automatically, and 9 mm bore pistols are prohibited firearms permitted for use only by the police and armed forces which invariably use hard-nose bullets in contradistinction to soft nosed ones used in sporting rifles against soft skinned game and which cause immense internal damage on the victim and huge wounds of exit, if any. We find that all six wounds of entry are of 0.8x0.8 cm. and with the exception of one, all exit wounds are also of almost similar dimensions. We are, therefore, of the opinion that injury no. 3 appears to be a wound of entry from a weapon firing hard-nose bullets which had penetrated the body and exited on the other side. We find support for this view from Modi (Supra) (at pgs.717-718). Because of obvious difference in design and construction, the wounds produced by hunting ammunition are much more devastating than that of the military ammunition. In military ammunition, the bullets are full metal jacketed having a core of steel or lead inside and are thus prevented from deformation (or expansion) when they hit the target. In contrast, a hunting bullet is designed to deform (or expand) in its passage through the body, producing an increase in its presenting area. Thus a hunting bullet, which is partially metal jacketed, but with the lead core exposed at its tip, is referred to as soft-point bullet. Hollow point hunting-bullets are also partially jacketed but have a cavity at the tip of lead core to facilitate expansion on striking the target. The silver tip hunting-bullet in reality is a soft point bullet whose lead core at its tip is protected by a thin jacket of aluminum alloy sheath. Modern steel-jacketed bullets used in army weapons have the shape of an elongated cone and owing to their great velocity usually pass straight and direct through the body without any deflection or deviation, and without causing much damage. The wounds of entry and exit are almost

circular and similar in appearance without any bruising or laceration of the surrounding parts\024.

19. The nature of injuries found on the dead body of Shesh Mani Rai are equally significant. It appears from injury nos. 1 and 2 which are on the neck and head respectively that the shot had furrowed through the body with a huge exit wound. The very dimension of these injuries show the presence of a rat hole type of entry with a larger wound of exit on the other side. Injury No. 3 substantially corresponds with the injuries found on the dead body of Vakil Shukla and reveals that this injury had not been caused with the weapon which caused the other two injuries.

The judgment cited by the learned counsel is therefore on its peculiar facts and based on the premise that the evidence in the case was doubtful.

20. We have also considered the arguments of learned senior counsel on the appeals against acquittal. We are of the opinion that the matter has been considered by the trial court and the High Court in its correct perspective and no interference is called for.

21. We accordingly dismiss all the appeal

9. VERSIONS

9.1 Accident or Murder?[1]

The fourth is that the gun, which the deceased Asghar Ali carried, after having obtained it under unexplained suspicious circumstances was a very defective weapon. According to Nigam, ballistic expert (P.W. 7), it was a 12 bore double barrelled breech loading hammerless gun. Although the normal trigger pull of such a gun is about 6-7 lbs. the trigger pull of this weapon was only 2 lbs. According to the witness:

> *If the cocked gun is thrown on the ground the butt-end giving it a jerk, the gun, Article A, fires automatically. If the barrel of the gun, Article A, is struck with some force with any hard substance, the gun discharges.*

In cases where the trigger pull is low possibility of accidental discharge is there.

The expert does not mention regarding its safety catch. When we examined the gun ourselves, we found that though it had a safety catch, it was so jammed that it did not work. There is no evidence to show that the police constable, Asghar Ali, was aware of all these defects and had taken precautions against its accidental discharge. It may well be that he did not know about the defects or may have thought, without properly testing the weapon that the safety catch was on, without realising that it was not on but jammed. Whatever that be, the prosecution has not explained why the deceased was carrying such a gun loaded with cartridges.

9.2 Murder, not Accident[2]

The only question for consideration is whether the evidence on the record could justify the finding of the High Court that the gun went off accidentally,

1. *Nirbhai Singh* v. *State of Madhya Pradesh,* 1972 Cr LJ 1474 (MP).
2. *State of Madhya Pradesh* v. *Dig Vijay Singh,* 1981 Cr LJ 1279 (SC).

or whether it was fired intentionally to commit the murder of Smt. Tulsa Bai. In this respect the following facts and circumstances have been fully established.

It has been proved by Bhanwar Singh (P.W. 22), who was the Station House Officer of police station Udaipura and investigated the case, that he recovered a muzzle-loading gun (article 'C') from the room where the dead body was lying on the bed with pellet injuries and that its licence Ex. P-15 was in the name of the respondent. It cannot, therefore, be doubted that the gun belonged to the respondent and was in his possession as it was recovered from the room where his wife died of gun shot in his presence. It will be recalled that the High Court had no hesitation in rejecting the respondent's defence that his wife had been killed by Jaswant Singh when he had gone out to answer the call of nature.

It has also been satisfactorily established by the evidence on the record that Smt. Tulsa Bai was unwell and was resting on cot inside the room of the respondent. This has been proved not only by the statement of Smt. Gomti Bai (P.W. 1) but also by the statements of several other prosecution witnesses including Prem Lal (P.W. 2) and compounder Hari Om (P.W. 4). The compounder not only gave a chloramine injection to Smt. Tulsa Bai shortly before the incident, but he also gave medicine to the respondent who said that he too was not feeling well. It has been proved by the statements of Smt. Gomti Bai (P.W. 1) and Prem Lal (P.W. 2) that the respondent also stated that he would take rest in the same room with his wife, and both of them stayed in it. Smt. Gomti Bai has clearly stated that the room was closed from inside and only the respondent, and the deceased were there.

It appears from the statement of Smt. Gomti Bai that when she took tea to the room of the respondent, she found that the door was closed from inside. She knocked at the door to get it opened, and called twice. When she called a third time, she heard the report of gun fire in the room. Immediately thereafter she saw the respondent opening the door, and coming out of the room. When he began to run away, she and Prem Lal went after him and informed Jaswant Singh who was near the house at that time.

It has been proved by the statement of village patel Shobha Ram (P.W. 3) that when he reached the place of occurrence after hearing the gunshot and shouts, he was asked by Jaswant Singh to go in the direction in which the respondent had run away. He did so, and reached village Ramkhiriya where he found the respondent at the house of Ram Narain (P.W. 4). He told the respondent that he had been called by Jaswant Singh, but he refused to go. He, therefore, informed Ram Narain that the respondent had come after shooting his wife and should not be allowed to escape. The statements of Ram Narain and his father Bhiya Lal (P.W. 8) corroborate the statement of Shobha Ram. The statements of these two witnesses as well as the statements of *chowkidar* Jawahar Lal (P.W. 6) show that while the respondent was under their watch, he rushed out of the house on the pretext of making water and was caught and brought back. He was ultimately taken to Mankapur and kept inside a room until the arrival of the police at about 2 a.m. The evidence on the record further shows that the respondent went out on the pretext of easing himself and jumped into a well from which he was rescued and taken in police custody.

The gun (article 'C') which was recovered from the room of the respondent near the dead body and was taken in police custody, was sent for examination by the ballistic expert (P.W. 10). He has stated that he found the gun in working condition and that its barrel showed signs of discharge. He has also stated the pellets which were recovered from the dead body could have been fired from it.

The above facts and circumstances are themselves quite sufficient to prove, beyond any doubt, that Smt. Tulsa Bai died as a result of gun shot injury from the gun of the respondent and in no other manner.

We have carefully examined the question whether the gun could have been fired in the scuffle to which reference was made by the respondent to Jawahar Lal (P.W. 6) and Ram Narain (P.W. 7). It is important to remember that Smt. Tulsa Bai was unwell and had been administered an injection of chloramine a little while ago. She was lying on her bed. The respondent also gave out that he was unwell and was lying on another bed nearly. It is difficult to understand why he, in that situation, should have thought of going to the field at that hour. Even if he wanted to go to the field, there was no necessity for him to load the muzzle-loading gun inside his room, and to ignore his wife's protests against his going when she was ill and did not want him to go. But apart from this, there are two important facts which completely disprove the theory of accidental firing which was set up by the respondent's counsel in the High Court.

Firstly, we find from the statement of (P.W. 14) that there were two apertures on the posterior fold of the left axilla of the deceased with blackening of the skin around them and the apertures were in the nature of wounds. On internal examination, he found that there was fracture of two ribs of the left side on the back. The two apertures were side by side. ***If it had been true that the gun went off accidentally during the scuffle with the wife the injuries would not have been on the back of her body but on some such part as could possibly come within the range of the gun during the scuffle. The position of the gunshot injuries, therefore, disproves theory of accidental firing and shows that the shot was fired while Smt. Tulsa Bai was lying with her back towards the respondent.*** It is also significant that the doctor was not even asked whether the injury could be caused in a scuffle by accidental firing. On the other hand, we find that the statement of the medical officer that if the firearm had been discharged very close to the body, the pellets would have entered the body en masse causing one wound, and not two apertures side by side, was allowed to go unquestioned.

Secondly, if there had been a scuffle, and if the shot had been fired while Smt. Tulsa Bai was preventing the respondent from going away, her dead body would not have been found lying on the cot, as it has been stated by S.I. Bhanwar Singh that the dead body was lying on the bed as shown in map Ex. P-5.

We are, therefore, satisfied that the High Court misread the evidence in arriving at a completely contrary conclusion. It is true that both Jawahar Lal (P.W. 6) and Ram Narain (P.W. 7) had stated that the respondent told them about accidental firing during a scuffle with his wife, but it was not the respondent's own case during the trial that the gun went off accidentally. On the other hand, he took the plea that he heard the gunshot while he had gone out to answer the call of nature and that it was Jaswant Singh who was responsible for the firing.

It was only when the courts did not accept that version, that the respondent's learned counsel thought of turning round and making his contention about accidental firing even though the respondent did not find it possible to set it up as a plea in his defence. The High Court also lost sight of the fact that the story of scuffle was not corroborated by the evidence on the record, and it erred further in stating, without any reason, that statements of Jawahar Lal and Ram Narain were sufficient to discharge the onus of proving accidental firing. The High Court tried to explain away the incapacity of Smt. Tulsa Bai to have any scuffle with her husband by saying that a stiff opposition need not have been offered by her and that "by touching the gun or any other part of the body of the accused the deceased may have desired the accused not to go to the field". But if there had been some such touching, it could not be called a scuffle and would not have led to the firing of the gun. In this respect also, the High Court misread the evidence on the record. The High Court has stated further that the "position of the injury" also showed that the injury "suffered by the deceased was not intentionally caused by the accused". It has further been stated by the High Court that "if the accused wanted to kill her, it is not likely that he would have caused the injury on the arm near the axilla". The record, however, reads otherwise for as has been pointed out, the position of the injury was at the back and was by itself sufficient to exclude any possibility of accidental firing during the course of a scuffle. It is difficult for us to appreciate what exactly is meant by saying that if the accused wanted to kill his wife, it was not likely that he would have caused the injury on the area near the axilla. The report of P.W. 14 shows that the gun shot caused apertures on the posterior fold of the left axilla and fractured two ribs on the left side of the back. The High Court, therefore, misread the evidence in holding that the injury was caused on the arm near the axilla. What the medical officer had stated was that he found charring on the left arm, and not that the injury was located there. Moreover, the High Court did not appreciate that even a gun shot injury on the arm or the axilla would have been sufficient to cause death and that, as it happened, the injury on the back did prove fatal.

It may be that the prosecution was not able to prove the motive for the crime, but that could not possibly matter when the circumstantial evidence on the record was sufficient to prove, beyond any doubt, that it was the respondent and no one else who intentionally caused the death of Smt. Tulsa Bai.

9.3 Murder, not Suicide![1]

It can be safely presumed that the deceased met her end at the alleged time and place from a gun shot fired from M.O.I. with the cartridge M.O. II. Suffice it to say that the doctor who held the post-mortem found one circular wound 1½" in diameter situated in the right flank below the rib margin of the right side, 6" from the spine and 11" from the shoulder in the midaxillary line. The surrounding skin was blackened and scorched. A small lacerated portion of the liver tissue was protruding. The wound was 6" deep and its direction was horizontal to the foot. Besides these, there was an ecchymosis 2" x 1" x 1"

1. *Lal Chhatrapati Rai* v. *State of Orissa*, 1976 Cr LJ 1342.

behind the elbow joint of the right arm. On dissection, the material things that he found within the wound were six pieces of round cardboard and eight pellets from the liver tissue, which were sent to the investigating officer. These were examined by P.W. 3, the ballistics expert according to whom, the gun was fired from an approximate distance of 3 to 4 feet from the victim, and that angle of firing was approximately little over right angle to the surface of the body. The ecchymosis was explained to be due to fall after receipt of gunshot.

P.W. 3 is the ballistics expert and his report, Ex. 6, shows that the gun, M.O. I was in good working order and that the residue from the right barrel indicated that M.O. II (the empty cartridge) had been fired from that barrel of the gun.

> *To certain suggestions indicating a case of suicide he has in his cross-examination negatived the theory when he stated that in view of the site of the injury and the angle of fire it is not possible that the injured could have shot herself to death. He further stated in cross-examination thus:*
>
> *"A person with longer arms than myself may be able to shoot the gun, M.O. I, at himself.*
>
> *If the gun, M.O. I, is firmly placed in position and then the trigger pressed by manipulation with a stick-like-article, it might be possible to shoot oneself".*

But such a contingency can be safely ruled out in view of the positive evidence in the case that the gun had been placed in a Khatuli (small charpoy) i.e., in its original position along with the rifle and the barrel was not towards the direction of the deceased. Further the cartridge, M.O. II, after firing, had been taken out from the magazine and placed on the table nearby. Such a situation is only possible when the assailant, after firing the shot, had enough time first to extract the cartridge and then place the gun and the empty cartridge in their respective places along with such other articles of the house as was found by the investigating officer.

The statement of the investigating officer concerning materials is thus:

> *"I found that the double barrel gun and a rifle had been placed on a* Khatuli *3½ feet from the head of the deceased. M.O. I is that gun, and M.O. IV is that rifle. The muzzles of both the guns were pointing towards the east. I also found that two 12 bore empty cartridges had been placed on a table over the khatuli and one of those cartridge cases smelt of gunpowder indicating recent firing".*

9.4 Self-defence, not Attempt to Murder![1]

It transpires from the prosecution evidence itself that before the shot from the double barrel gun was fired at Jeet Singh, the appellant asked Jeet Singh, and his brother to go out of the land but they asserted their right to hold the land in question and refused to go out. Thus, the trespass committed by Jeet Singh and his brother on the land had not come to an end and the appellant had a right to prevent them from continuing to commit criminal trespass.

As regards the extent to which the right of private defence of property could be exercised by the appellant in the circumstances of the case, it may be observed that he had not exceeded such right. He fired a single shot from his double

1. *Karnal Singh* v. *State of Rajasthan,* 1977 Cr LJ 1729.

barrel gun at Jeet Singh from a distance of 45 ft. When Jeet Singh fell down, as a result of the injury caused by some pellets discharged from the gun, the appellant did not fire any other shot at Jeet Singh or at his associate. On the basis of the facts proved in this case, I have no hesitation in holding that the appellant did not exceed his right of private defence of property.

As regards the appellant's conviction, under section 27 of the Arms Act, it may be observed that it is not made out against the appellant, because I have already held above that the appellant used his gun in exercise of his right of private defence of property. Section 27 of the Arms Act contemplates possession of arms or ammunition "with intent to use the same for any unlawful purpose or to enable any other person to use the same for any unlawful purpose". In the absence of any proof regarding intention of the appellant to use the gun for any unlawful purpose, his conviction and sentence under section 27 of the Arms Act cannot be allowed to stand.

The result of the above discussion is that I accept the appeal filed by Karnail Singh, set aside his convictions and sentences under section 307, I.P.C. and section 27 of the Arms Act and acquit him of both the aforesaid offences.

9.5 Conflicting Versions[1]

The High Court noted that a number of contradictions were pointed out in the account given by the eye-witnesses P.W. 3, P.W. 4, P.W. 5, P.W. 6, P.W. 7, and P.W. 31 and that the prosecution has not been able to explain the injuries which Nadar had on the palms of his hands which injuries, according to the High Court, indicated that he was protecting himself against gun fire. It is also observed that the contradictions were not minor as they related to the spot of the murder, the fields through which the accused passed and the manner in which the killing took place. There is also the question of incompatibility with the medical evidence regarding the distance from which the gun was shot and the way it was shot. It was of the view that the incised wounds were more likely to have been caused after death and the likelihood of a false story of knives of the assailant cannot be ruled out. As regards firing of a pistol, there is absolutely no corroboration and the evidence was characterised as a myth. The hole in the shirt could have been only caused by the firing of the pistol and nothing collected on the spot showed that Sohrab fired a pistol or he fired a pistol on Sobalsingh. The story of the pistol was, therefore, discarded. Notwithstanding these findings, the High Court found that there was unanimity in the evidence of all the witnesses that Sohrab fired the fatal shot or shots with a gun given by Nadar. This was corroborated by the medical evidence which indicates that the injuries on the deceased were due to gunshot injuries. There is also the evidence of the incident having taken place in a field in which the deceased was found and there was unanimity on the point that Nadar handed over the gun to Sohrab and Sohrab fired a shot on Sobalsingh who fell down after which a second shot was fired. The version of the accused that the gun shot injuries were caused accidentally will not be believed. The defence story that Nadar was easing himself when he was attacked all of a sudden after which a scuffle

1. *Sohrab* v. *State of Madhya Pradesh,* 1972 Cr LJ 1302.

between Sohrab and Sobalsingh took place resulting in the accidental firing of the gun was difficult to be comprehend. The High Court however dealt with the several contentions urged in respect of the story that Nadar had handed a gun to Sohrab which he could have easily fired himself or that Nadar who is said to have caught Sobalsingh from behind should have been the first to have been injured, or that the directions of the injury on Sobalsingh indicates that the firing was from below when Sohrab was at a higher level, or that the witnesses could not have been seen from the place where they were or that Sohrab fired at Sobalsingh, or that he fired it when its barrel was at a distance of 1½ cubits from Sobalsingh were all discussed, but they were not considered to throw any doubt on the main version of the eye-witnesses that it was Sohrab who had fired the gun while Nadar held the deceased. The conclusions of the High Court have been set out as under:—

> *The argument that the shooter should have been at a level lower than the victim and such a state has not been told by witnesses. Rather the story clearly excludes such a possibility has, no doubt, some merit if we accept the story of the prosecution witnesses as told by them. We do not fully accept the same. In fact they saw the incident from a distance and the detailed descriptions are all inferences as even admitted by one of them. A man running for life and a mare following would be away quite far from the witnesses. Number of fields mentioned by the witnesses intervened the witnesses and the spot. In fact it has been a point taken up by the defence that on account of the distance they could not see. What we feel is they could see the broad facts, Sohrab's running on a mare, broad and easily visible actions that one could see from a distance. The rest of the details are imaginations and inferences. Nadar's injuries on his palms cannot be explained strictly on the basis of the prosecution version; but as we have seen the details are unbelievable we can only say the witnesses could not see how the injuries on Nadar's palms were received. They were received undoubtedly on the spot and when gun was fired, Sobalsingh was no doubt held or appeared to have been held by Nadar from a distance. He must have tried to move, that moment was responsible for injury to his palms. The unassailable story, therefore, remains is that Sohrab fired a gun at sobalsingh and Nadar handed over the gun to him. Both of them are therefore guilty."*

In the above view it was held that both Sohrab and Nadar were guilty of an offence of murder under section 302 read with 34.

9.6 Wrong Prosecution Version[1]

Appellant Suraj Pal Singh is said to have snatched the gun of Sheo Mangal Singh (since acquitted). The latter was also a gun licensee. His gun was seized. The Ballistics Expert could not connect any of the empty cartridges as having been fired from this gun. As admitted by one of the prosecution witnesses, Sheo Mangal Singh was ill and confined to bed at the time of the occurrence. His presence, therefore, at the place of the occurrence, was not only doubtful, but perhaps false, as noticed by the High Court. That being so, the prosecution story of Suraj Pal Singh having used Sheo Mangal Singh's gun became very

1. *Birpal Singh* v. *State of Uttar Pradesh,* 1977 Cr LJ 1738: AIR 1977 SC 2083.

very doubtful. If the prosecution evidence was correct as to the firing of a gun shot by Suraj Pal Singh then the wound of entry ought to have been found on the inner side of the left arm of Ram Lal because he had raised his arms before the shot hit it. But it was just the reverse. The wound of entry was on the outer side of the left arm. The prosecution case, therefore, against appellant Suraj Pal Singh was very very doubtful and the High Court was not justified in convicting him.

9.7 Inexperience Responsible for Wrong Version[1]

It may be pointed out that P.W. 12, was not a very experienced doctor when he had appeared in the witness-box. He passed his M.S. examination in 1971 and had entered in government service on 26th December, 1970. This was admittedly the first post-mortem examination he had performed. He is also not definite in his opinion whether the injuries in question were the result of one gunshot or of two gunshots. He has qualified his opinion by stating that the wounds were caused most probably by one shot but he cannot say definitely because of the fact that pellets were of two different sizes. No doubt at another place the witness has stated that there was one entry of gunshot wound and there were two exit wounds and injury No. 3 was probably due to exit of one or two pellets. The evidence of the doctor, in our opinion, does not exclude the possibility of there being two gunshots which may have struck the deceased. May be, that the second gunshot alleged to have been fired from behind by the assailant while the deceased was running, was not effective. On the basis of indefinite opinion of the medical expert as in the present case, we are not prepared to reject the direct evidence.

The learned public prosecutor has also urged that most of the pellets of the second gunfire may not have hit the victim on account of wide dispersion and the eye-witnesses may have thought that the second, shot hit the back of the deceased. The explanation furnished by the learned public prosecutor cannot be said to be altogether devoid of force.

In *Mohanlal* v. *State of Rajasthan*, 1961 Cr LJ 155, it was observed that:—

> *"There is always a tendency to over-emphasize discrepancies between the evidence of eye-witnesses and medical testimony. These discrepancies should be treated and appraised just like other discrepancies in the statements of the witnesses. It cannot be forgotten that the eye-witnesses may not give a very correct and accurate account of the version and may at places make exaggerations or may fail to give correct facts either on account of lapse of memory or on account of inability to observe minutely or to recite correctly. It should also be borne in mind that some times the medical officers also do not bestow sufficient care while performing examinations and their opinions may not be properly formed on account of inadequate or defective examinations or lack of complete knowledge. It is, therefore, hardly fair to expect a complete and perfect correspondence between the medical evidence and the eye-witness testimony. Naturally, therefore, the court may carefully examine the discrepancies and if it is reasonably open to arrive at a substantial and true version of the prosecution case, the courts should*

1. *Hussain Khan* v. *State of Rajasthan*, 1976 Cr LJ 821.

not adopt the easy course of throwing away the prosecution case on the alleged discrepancies between the medical evidence and the eye-witness testimony".

In *Nankhusingh* v. *State of Bihar*, (1972) 3 SCC 590: 1972 Cr LJ 1204 their lordships of the Supreme Court observed as follows:—

"When a person fires at a place where there are two persons, one witness may think that it is fired at one person and the other may think that it was fired at the other. Merely because the inference drawn by one witness which may not fit in with the inference drawn by the other the factum of the firing at the place where the injured persons were, cannot be rejected. It cannot be held that the witness is a liar and he wanted to falsely implicate the appellant and others".

Again in *Nihal Singh* v. *State of Punjab*, AIR 1965 SC 26: (1965) 1 Cr LJ 105 an argument regarding contradiction between medical evidence and direct evidence was repelled by their lordships of the Supreme Court in this way:—

"Another fact relied upon by the learned additional sessions judge in discrediting the eye-witnesses is that the witnesses stated that the deceased gave a Takwa *blow on the head of Nihal Singh, but the medical examination showed only a small abrasion on his left thumb. The High Court explained that the witnesses must be describing only the movements of the accused with their weapons and they could not obviously give evidence as to where a particular weapon hit the body, for that would depend upon not only the manner in which the person wielded their weapons but also on the movement of the victim. A hit aimed at the head may, if the victim moves aside, miss altogether the body of the victim or fall on a part of his body different from that aimed at. There is certainly force in what the High Court said".*

Applying the reasoning adopted by their lordships of the Supreme Court in the cases cited above, the so-called contradiction or conflict between medical evidence and direct evidence pointed out by the learned counsel in the present case is, in our opinion, clearly explicable. May be, that the second shot did not hit the victim and the witnesses may have got an impression that the shot hit the victim on the back. May be, that only a few pellets of the second shot hit the victim and the rest went amiss. In our opinion, nothing turns upon this so-called contradiction or conflict between medical evidence and direct evidence.

In respect of P.W. 5, Smt. Jannat's statement, the learned counsel has drawn our attention to another discrepancy and it is this that Smt. Jannat states that the victim was at a distance of about one pace (roughly five feet) from the muzzle, whereas according to P.W. 3, Khanu, the accused fired the gunshot which hit Gamu from a distance of about six to seven paces. In our opinion, nothing substantially turns upon the discrepancy in the distance.

In *Janak Singh* v. *State of Uttar Pradesh*, AIR 1972 SC 1853: 1972 Cr LJ 1177 their lordships of the Supreme Court observed as follows:—

"According to Dr. Ghosh's evidence, none of the three entry wounds showed any blackening or tattooing. Obviously, therefore, the firing did not take place from a very close range but from some distance at least. No doubt, the three eye-witnesses gave different distance ranging from two to six paces. But they could hardly be expected to have marked at the time the precise distance at which the

person shooting the firearm was. They, therefore, gave an estimate of the distance at which he was from the victim. It is wonder that the distances they deposed varied. Nothing can, therefore, turn on such variation".

10. MISCELLANEOUS

10.1 Arms and Ammunition[1]

The importance in a criminal trial of such material to be placed by the prosecution on record cannot but be emphasised because of the definition available in section 2(I)(b) of the term "ammunition" and of the term "arms" in section 2(1)(c). In the term of "ammunition" which must be the ammunition for the purpose of firearms several items are included which show the range right from rocketry to small balls useable as ammunition which can be ejected and exploded effectively through the mechanism of firearms. In the inclusive definition even the ingredients of ammunition as the Central Government may by notification in the official gazette specify are treated to be the ammunition. It is, therefore, of essence, if the charge is that the accused was in possession of ammunition, that it must be told to him what type of ammunition he was possessed of and that can only be done if the prosecution is careful enough to ascertain whether the accused was in possession of the ammunition within the meaning of the provisions of the Act and if so what type. Mere visual examination of an article seized from the accused by the police in a given case may be a poor substitute. There may be articles which have a look of an ammunition but may not in fact be an ammunition. It is not for the accused to explain the things which the prosecution wants to rely upon. The general impression of Punjabrao with regard to the so-called ammunition cannot thus be the basis for conviction in a criminal trial unless it is established to the satisfaction of the court that in fact what was seized from the accused was the ammunition within the meaning of the Act. This is more so for the term "ammunition", apart from the definition, is indicative as conveying projectiles used with ordnance, rifles and similar weapons, together with the requisite propellants, fuses cartridges and means of ignition. There are further technical classifications available, such as projectiles, cartridges, the means of ignition and the fuse. It follows, therefore, that the prosecution cannot be relieved of the onus to establish that the material brought before the court answers the term "Ammunition".

Similar is the position with regard to the definition of the term "arms". The definition takes in the articles designed or adapted as weapons for offence or defence. Merely because an article has a trigger or a handrest and has a look like that of a gun or pistol, that would not be enough to show that it is a weapon which can be used for the offence or defence. The prosecution is bound to establish that the article brought before the court and seized from the accused in a given case is a weapon in that it is capable of inflicting injury as a means of defence. The definition further shows that if there are recognised firearms, the same are included in the definition. So also is the case with regard to the sharp edged and other deadly weapons and parts thereof and even the machinery for manufacturing arms is treated as the arms.

1. *Gulijarsingh* v. *State of Maharashtra*, 1976 Cr LJ 2056.

The definition being inclusive would include all types of weapons which can conveniently come under the description and designations of firearms, sharp edged and other deadly weapons and part thereof as well machinery for manufacturing arms. To clarify that certain articles though they may answer this terminology will not be "arms", the definition goes on to exclude articles which are designed for domestic or agricultural uses, such as *lathis* or working sticks as well the weapons which are incapable of being used otherwise than as toys or of being converted into serviceable weapons. These terms of the definition having inclusive as well excluding parts will have to be kept in view while trying an accused for possession of "arms". Though an article that looks like a weapon may be seized from the accused, it may still not be the "arm" within the definition of the Act and it will have to be shown by evidence that the thing seized was a weapon within the meaning of the definition. In a given case the very article tendered in evidence may substantiate the requirement and the court will be in a position by the very tender of that to find so.

In a given case if the articles are sharp-edged and deadly weapons, the court may by mere look at it form its opinion and may conclude that answers the terms of "arms". But when the case is of a mechanical device and complicated we aponry same said opinion could not be formed. A thing that looks like a gun or a pistol, must possess, to be an arm, a potentiality of a weapon, for it must be shown that it has capacity to eject the ammunition by its very design. Unless evidence is forthcoming, the matter should not be allowed to rest on mere visual examination. For though an article present a look of "an arm" it may on test prove a useless gadget or a mere show-piece. Advisedly such exclusion has been made part of the definition of the term "arms". Without even doubting the experience of P.S.I. Punjabrao, it is amply clear in the present case that there is no material placed by the prosecution to prove that articles seized are "arms". The evidence of P.S.I. falls too short of the requirement and cannot be treated as sufficient on this aspect.

10.2 Possession[1]

Though both the courts found on facts that the petitioner has committed an offence under section 27 of the Arms Act, I am unable to agree with the same. It is very doubtful whether the petitioner was armed with a gun at all at the time of the occurrence. The petitioner has clearly stated in his statement that there was a wordy quarrel at the time of the alleged occurrence and that P.W. 1 had falsely implicated him as if he was armed with a gun and attempted to shoot him. One clinching circumstance rendering the version of the revision petitioner probable is that if he really had a weapon, P.Ws. 1 and 2 who claimed to have over-powered the petitioner when he was alleged to have attempted to use the gun, could have seized the gun also. P.Ws. 1 and 2 would not have allowed the petitioner to go away with the gun when they would say that they had over-powered him. The gun was seized subsequently only from the house of the revision petitioner. I am unable to accept the evidence of P.Ws. 1 and 2 in this case that the petitioner was armed with the gun at the time of the incident. On this point alone, the petitioner will be entitled to an acquittal.

1. *S.S. Sundaram (in re:),* 1975 Cr LJ 1196 (Mad).

Even assuming that he had a gun at the time of the occurrence, since both the courts found that he had not used the gun, it cannot be said that he was carrying the gun with the intention of using the same for unlawful purpose. When the purpose for which the gun was said to be used is negatived, the question that the gun was taken with the intention of using it for an unlawful purpose does not arise. Therefore, the conviction and sentence imposed on the petitioner are set aside.

For possession of weapon without licence and conviction see *Jarnail Singh* v. *State of Punjab*, AIR 1999 SC 321; *Ram Kumar* v. *State (NCT) of Delhi,* AIR 1999 SC 2259; *Subhash* v. *State of Haryana*, AIR 1999 SC 1463; *Jaspal Singh* v. *State of Punjab*, AIR 1999 SC 1548. For acquittal, see, *Chitwant Singh* v. *State of Punjab*, AIR 1999 SC 1606.

10.3 Unreliable Evidence of secreted Arms/Ammunition[1]

The clinching question is whether the appellant who pointed out the arms and ammunition had not himself hidden them. As earlier noticed, the petitioner while in police custody made a statement and led the police party to the land and the house of Fakir. The hypothesis that someone told the accused appellant of the place of secretion is displaced by the very knowledge displayed, for it is unnatural that such details of secretion would be conveyed to the petitioner out of mere idle curiosity. That apart this hypothesis is totally vacated as the appellant had not revealed the name of the person who has imparted to him the precise information, for it is improbable to believe that the accused was prepared to lose his liberty for the sake of his friendly obligation to keep it secret, nor is it reasonable to expect any sense of moral obligation in one who has not moved the authorities in the matter till he was himself suspected in connection with the dacoity case and questioned.

The conditions under which these arms and ammunitions were recovered show that they were kept and secreted with care and as such *mens rea* was also there. The Punjab High Court in the case of *State of Punjab* v. *Mahinder Singh*, AIR 1953 Punj 81 with reference to an offence under section 19F of the old Act observed:

> *"The evidence of the various witnesses shows that the accused made a statement to the police and also pointed out the place where the pistol was and brought it out. This evidence, in my opinion, is sufficient to prove the control".*

The appellant hiding the arms and ammunition in the facts and circumstances of the case must be held to be in possession of the same. The explanation the petitioner had given while he was examined under section 342, Cr. P.C. is no explanation at all and in fact it is false. In *Mohan Lal* v. *State of Uttar Pradesh*, AIR 1974 SC 1144 the Supreme Court observed:—

> *"Indeed among the circumstances which go against the accused's innocence is the falsity of this plea he put forward. It is not illegal to take into consideration this circumstance also, if there are other compelling materials bringing home the guilt of the accused".*

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1. *Dipu* v. *State of Uttar Pradesh*, 1977 Cr LJ 1508.

10.4 Pistol/Gun?[1]

The main point raised by the learned counsel for the appellant was that the weapon said to have been fired by appellant Vikram Singh had been referred to in the first information report and also at the investigation stage by the witnesses as a pistol while it was in fact a sten gun. It was, therefore, contended that if it was a day-time occurrence and the witnesses had seen the firing, they should not have committed such a blunder in description of the weapon. It was urged that for this reason, the entire prosecution case should be thrown out. It is, of course, evident that in the first information report and at the investigation stage the weapon used by Vikram Singh has been referred to as a pistol. The question now is how far this misdescription affects the oral evidence. The eye-witnesses, when questioned on the point deposed that they did not know what a sten gun was and that to their knowledge, the weapon was a pistol. Sten gun is a weapon which few people have an occasion to see. The common man is not expected to know what a sten gun is and what it is like, the only fault of the witnesses was that instead of saying that they had seen some firearm the like of which they had not seen before and did not know its name, the witnesses ventured to describe the weapon as a pistol. We have given our anxious consideration to the various circumstances and we think that such a misdescription of the weapon does not shake the very foundation of the prosecution story. As already observed, it cannot be said that a sten gun and a pistol are so dissimilar that a witness could never have committed a mistake of this sort. While describing the weapon in the first information report or at the investigation stage, it was not said that it was a country made pistol or a regular pistol or foreign make. It is a matter of common knowledge that some country-made pistols have long barrels also. It is, therefore, no wonder that after seeing the large size of the barrel, the witness gathered an impression that the weapon was country-made pistol.

Thus all the witnesses deposed that they had seen only the barrel portion and we think that this is quite natural under the circumstances. After seeing the extra large size of the barrel the only impression which the witnesses could naturally gather was that it must be a country-made pistol. By merely seeing the barrel probably even a more experienced man could not have, in that state of excitement, noted that it was really a sten gun. Thus having considered all these facts and circumstances, we do not find any substance in this argument.

For firing from the gun and conviction of the accused, see, *Prakash Dhawal Khairnar Patil* v. *State of Maharashtra*, (2002) 2 SCC 35.

10.5 Number of Projectile in 12 Bore Cartridge[2]

This appeal by special leave arises out of the following facts.

One Lal Singh had three sons, Hari Singh, Jaswant Singh and Birbal Singh. Brij Pal Singh PW 1, Ved Pal and Gajender Singh are the sons of Birbal Singh whereas Suraj Bhan, Netar Pal and Satbir Singh are the sons of Jaswant Singh and Ram Pal and Ram Saran, the accused are the sons of Hari Singh. Hari Singh predeceased his father Lal Singh whereafter the joint land holding was

1. *Vikram Singh* v. *State of Uttar Pradesh*, 1978 Cr LJ 1335.
2. *Ram Pal* v. *State of Uttar Pradesh*, 2008 Cr LJ 1395 (SC).

partitioned by Lal Singh between his sons Jaswant Singh and Birbal Singh and the sons of Hari Singh deceased in equal shares retaining 18 bighas for himself. About 2-3 years prior to the incident Ram Pal Singh staked a claim that the tube well on the land was his exclusive property on the plea that the electricity connection was in his father's name. Several civil and criminal litigations followed on account of this dispute and certain other matters with the result that the relations between the accused and Birbal Singh degenerated to an all time low and about two days prior to the occurrence, an altercation had taken place between Birbal Singh and his son Brij Pal Singh on the one side and the accused on the other, relating to the use of the tubewell water. At about 8.30 A.M. on 20th June, 1991, Birbal Singh accompanied by his brother Jaswant Singh and his son Brij Pal Singh left the village to go to Muzaffarnagar for purchase of household articles when they were accosted by the two accused, Ram Pal carrying his licensed DBBL .12 bore shotgun, and Ram Saran armed with a country made pistol and the accused fired a shot each in quick succession hitting Birbal Singh killing him instantaneously Jaswant Singh and Brij Pal Singh saved themselves by lying prone on the ground. The incident was also witnessed by several other persons who were passing by amongst them being Harvir Singh PW 2, Tejvir Singh PW 3, Amar Singh and Matroo Singh and on their challenge the assailants ran away. Brij Pal Singh PW 1 thereafter rushed to the village, wrote out a report and then went to police station Tetawi six kilometers away from the place of incident in a tractor and handed over the written complaint at 10.30 a.m. leading to the registration of the FIR. SHO Brij Mohan Mishra accompanied by SI Rajinder Singh then reached the place of occurrence whereafter the SI recorded the inquest proceedings relating to the murder. He also picked up a spent cartridge case and wads of a shotgun cartridge and dispatched the dead body for the post mortem examination. He also conducted a search of the house of Ram Pal and Ram Saran on 21st June, 1981 and recovered a DBBL gun and 10 live cartridges licensed to the former therefrom. The weapon and the cartridge case were sent to the Forensic Laboratory and its report revealed that the cartridge had been fired from the right barrel of the gun in question. On the completion of investigation, the accused were charged for offences punishable under sections 302/149, I.P.C. and they pleaded not guilty and claimed trial.

Mr. Mahavir Singh has also seriously challenged the Forensic evidence in this case by arguing that though the spent cartridge case had been picked up from the spot on 20th June, 1981 and the gun recovered the next day, both these items had been sent to the laboratory only on 17th September, 1981 and as the 22 pellets recovered from the dead body had not been sent to the laboratory there was no justification in holding that the weapon had in fact been used in the murder. In support of his case Mr. Mahabir Singh has relied on *Palia* v. *State of Punjab*, 1997 SCC (Cri) 383: 1995 AIR SCW 3026; *Baldev Singh* v. *State of Punjab*, (1990) 4 SCC 692: AIR 1991 SC 31; *Santa Singh* v. *State of Punjab*, AIR 1956 SC 526. He has also urged that as PW 10 Brij Mohan Mishra in his cross examination had testified that there were about 7-8 small shots in a .12 bore cartridge, the recovery of 22 pellets from the dead body and the note regarding the smell of gun powder from the barrel of the gun, falsified the prosecution story.

We have considered these arguments very carefully. We first note that the facts that the cartridge case had been left by assailants at the spot and that the shots had been fired from a shotgun and a pistol find mention in the FIR. Interestingly also, there is a suggestion by the defence in the cross-examination as to whether the spent cartridge had been found near the dead body or at some distance therefrom. It is also clear from the statement of Ram Pal recorded under section 313, Cr. P.C. that the gun which was licensed to him had been recovered from his house along with 11 cartridges. We have also perused the statement of PW 7 HC Rameshwar Prasad who stated that the weapon and other articles have been sent to the Muzafarnagar city Malkhana on 2nd July, 1981 but had been returned to the police station as there was no place for storage and had been returned to the Malkhana on 13th July, 1981 awaiting re-transmission to the laboratory. We also note from the statement of PW 9 Randhir Singh a retired constable who was at the relevant time the moharrir of the Malkhana at Muzafarnagar in the police station that the weapon and cartridge in a sealed condition had been deposited with him on 2nd July, 1981 and had not been tampered with till their dispatch to the Forensic Science Laboratory. We have also gone through the statement of Om Prakash Tripathi PW 8, the expert in the Forensic Science Laboratory who had examined the KF .12 bore fired cartridge case and DBBL gun No. 7902082 and had found that the said cartridge had been fired from the right barrel of the gun.

Seizing on the fact that 22 pellets had been recovered from the dead body and that PW 10 SHO Brij Mohan Mishra had deposed that a .12 bore cartridge contained only seven to eight pellets, Mr. Mahabir Singh has submitted that the prosecution story was on the face of it unacceptable. We find absolutely no merit in this plea. It has some in the evidence of PW-8 Om Parkash Tripathi that the cartridge used was of KF make (KF stands for Kirkee Factory). It is therefore, a cartridge manufactured by the Indian Ordnance Factory, at Kirkee, which has, off and on, been manufacturing cartridges of shot sizes BB to 9 only (this information has been reconfirmed from the Secretary, National Rifle Association of India, New Delhi).

A 12 bore shotgun cartridge carries a shot charge of twenty-five to thirty-five grams in weight and varying number of pellets based on several factors such as the length of the cartridge as would be clear from the following chart taken from **Forensic Science in Criminal Investigation and Trials** *by* ***Dr. B.R. Sharma (4th Edn.) at page 416:***

Projectile charge of Cartridges

Number	No. of Pellets Per 28.35 g.	Pellets diameter mm	Pellet weight in g
LG	6	9.14	4.54
SG	8	8.43	3.54
Special SG	11	7.57	2.58
SSG	15	6.83	1.89
AAA	35	5.16	0.81

Number	No. of Pellets Per 28.35 g.	Pellets diameter mm	Pellet weight in g
BB	70	4.09	0.40
1	100	3.63 (.16″)	0.28
2	120	3.41 (.15″)	0.24
3	140	3.25	0.20
4	170	3.05 (.13″)	0.17
5	220	2.79 (.12″)	0.13
6	270	2.59 (.11″)	0.10
7	340	2.41 (.10″)	0.08
8	450	2.21 (.09″)	0.06
9	580	2.03 (.08″)	0.05
Dust	2770	1.2192	0.0109

N.B. The equivalent in inches of the pellet size shown in brackets in the third column has been taken from *Lyons Medical Jurisprudence and Toxicology*, 11th Edn., page 913 and superimposed in the chart.

From the above table it can be concluded that KF manufactured cartridges can contain between 70 (BB) to 580 (9) pellets per cartridge. The 7-8 pellets that have been referred to by PW Brij Mohan Mishra would be pellets of buck shot such as SG/LG which are not manufactured by the Kirkee Factory. The post-mortem report also shows that there were multiple wounds of entry 1/8th of an inch over the whole of the chest and upper half of abdomen in an area of 14 x 12, which confirms Brij Pal's statement that the two shots had been fired from a distance of about 40 or 50 feet. We are of the opinion that on account of dispersal of the pellets at that range, not all would have struck home. The recovery of 22 pellets therefore fits in with the prosecution story. The argument based on the gun powder smell from the barrel is equally without substance. In *Modi's Medical Jurisprudence and Toxicology*, 23rd Edn. (Page 723) while dealing with the topic as to *"the time when the weapon was fired"* it has been observed that "it is never possible to ascertain with any scientific accuracy the time when a weapon or cartridge was fired". In this situation, the judgments cited, which are based on their special facts, have no relevance to the facts of the present case.

We are therefore, of the opinion that no fault can be found with the judgment of the High Court. We accordingly dismiss the appeal.

10.6 SBML *v.* DBML Guns[1]

Briefly stated the facts are as follows:—The accused and the prosecution witnesses are all from the same village Sug Tarkhana, Tehsil Indora, District Kangra. The accused and PW-5 Gian Chand were at loggerheads over the dispute of abadi and civil litigation between them was pending. The deceased Uttam Chand was employed as a carpenter at Delhi and had come to village on 5-8-1995 to attend the performance of first death anniversary of his mother. It is stated that on 14-8-1995 at about 10.00 a.m. Gian Chand - PW-5 had an altercation and

1. *State of Himachal Pradesh* v. *Mast Ram,* AIR 2004 SC 5056.

quarrel with the accused Mast Ram with regard to the dispute over the abadi and the deceased Uttam Chand said to have intevened and advised both Gian Chand and Mast Ram not to quarrel and wait for the decision of the court in civil litigation. Thereupon, the accused Mast Ram became furious and threatened the deceased Uttam Chand that he would deal with him first of all as he was siding with Gian Chand with whom the accused had the civil dispute over the abadi. It is further stated that at about 10.30 a.m. on the same day, when the deceased Uttam Chand along with his brother Hans Raj PW-1 and Vijay Kumar PW-3 was proceeding towards the fields to get fodder for the cattle and was passing through the passage in front of the house of the accused Mast Ram, the accused with DBML (Double Barrel Muzzle Loaded) gun in his hand challenged Uttam Chand stating that he would be done to death and then fired at Uttam Chand. The deceased Uttam Chand received injuries on his arm, chest and shoulder, fell down on the ground, and became unconscious. Thereafter, the accused ran away towards the field with his gun. In the meantime, PW-4 Tarsem Lal also arrived and PWs. 1, 3 and 4 together shifted the deceased Uttam Chand to his nearby house where he breathed his last after sometime. The matter was reported to the Pradhan of the village, who advised to lodge a report with the police and the First Information Report was, accordingly, lodged. The accused was arrested on 18-8-1995 by PW-15 and pursuant to a disclosure statement, the DBML gun (Ex. P-11) was recovered from underneath the bushes near his house. Ex. P-11 was sent for examination to the Forensic Science Laboratory and it was found to be in working condition and having been fired. The accused pleaded ignorance in his statement under section 313 but he did not lead any defence evidence. The spot inspection, was however carried out at the request of the accused in his examination under section 313. It appears that the defence of the accused in his examination under section 313 was that from the place where the accused is alleged to have fired at the deceased and the place where the deceased was standing and hit by the gun shot was not within the firing range. This has led to the trial Court for spot inspection. The inspection was carried out by the trial Court on 25-2-1996 in the presence of the accused, his counsel and the Public Prosecutor. The trial Court conducted a test gun shot fire from the place where the accused was alleged to have fired at the deceased and it was observed that the place where the deceased was standing and hit by the gun shot was within the firing range.

The trial Court after considering the evidence and eye witnesses accounts of PWs 1, 3, 4 and PW-2-Dr. Sanjay Kumar Mahajan, who conducted the post-mortem examination and the report of forensic laboratory has recorded findings that the prosecution has established his case beyond all reasonable doubts and convicted the respondent as aforesaid.

The High Court upset the conviction recorded by the trial Court, firstly that the DBML gun (Ex. P-11) alleged to have been used in the commission of offence was not used in a test fire at the time of local inspection conducted by the trial Court and instead a test fire was carried out with the help of SBML (Single Barrel Muzzle Loaded) gun belonging to PW-1 Hans Raj. The High Court held that this has materially affected the prosecution story. According to the

High Court, the firing range differs from gun to gun and, therefore, the firing test not having been conducted from the Exhibit P-11, the finding of the learned trial Court Judge that the deceased has been hit by the gun shot was within the firing range from the verandah of the house of the deceased could not have been relied upon. This finding, in our opinion, is not only fallacious but also perverse. While it is true that generally, the firing range of the gun differs from gun to gun, the opinion of the High Court that firing range of DBML gun and SBML gun differs is based on no expert opinion and the same is based on conjectures and surmises. In the instant case both the guns are of the same categories except the one used in the commission of crime is Double Barrel and the one used during the test fire was the Single Barrel. Therefore, it cannot be said that the firing range from DBML gun differed from SBML gun or *vice-versa*.

That apart, the local inspection envisaged under section 310, Cr. P.C. is for the purpose of properly appreciating the evidence already recorded during the trial. Memorandum of spot inspection recorded by the trial Judge has to be appreciated in conjunction with the evidence already recorded. Any omission and/or commission in the memorandum recorded by the trial, Judge by itself would not constitute material irregularity, which would vitiate the prosecution case. In our view, it is difficult to accept the reasoning recorded by the High Court in this regard.

Secondly, the ground on which the High Court has thrown out the prosecution story is the report of ballistic expert. The report of ballistic expert (Ex. P-X) was signed by one junior scientific officer. According to the High Court, a junior scientific officer (Ballistic) is not the officer enumerated under sub-section (4) of section 293 of the Code of Criminal Procedure and, therefore, in the absence of his examination such report cannot be read in evidence. This reason of the High Court, in our view, is also fallacious. Firstly, the Forensic Science Laboratory Report (Ex. P-X) has been submitted under the signatures of a junior scientific officer (Ballistic) of the Central Forensic Science Laboratory, Chandigarh. There is no dispute that the report was submitted under the hand of a Government scientific expert. Section 293(1) of the Code of Criminal Procedure enjoins that any document purporting to be a report under the hand of a Government scientific expert under the section, upon any matter, or thing duly submitted to him for examination or analysis and report in the course of any proceeding under the Code, may be used as evidence in any inquiry, trial or other proceeding under the Code. The High Court has completely overlooked the provision of sub-section (1) of section 293 and arrived at a fallacious conclusion that a junior scientific officer is not an officer enumerated under sub-section (4) of section 293. What sub-section (4) of section 293 envisages is that the court to accept the documents issued by any of six officers enumerated therein as valid evidence without examining the author of the documents.

Thirdly, the High Court was of the view that during the course of post-mortem examination conducted by PW-2 Dr. Sanjay Kumar Mahajan, two pellets were recovered - one each from the right and left lung of the deceased, which were handed over to the police. However, the pellets recovered were never sent for examination to a ballistic expert in order to find out if such pellets were

fired from the gun (Ex. P-11) or not. According to the High Court, failure of the prosecution to send the pellets for examination by a ballistic expert will draw an inference against the credibility of the prosecution story. This finding, in our view, is utterly perverse. It is not the requirement of law that pellets recovered from the body be sent to ballistic expert to determine as to whether the pellets were fired from the exhibited gun or not. On the contrary, the recovery of pellets from the body clearly establishes the prosecution case that the deceased died of gun shot injuries.

The fourth reason assigned by the High Court in discarding the prosecution story is with regard to the non-explanation of injury No. 2. on the body of the deceased. The injury No. 2 was described as under:—

"A circular area about 1.5 cm diameter in left axilla towards left arm."

PW-2 Dr. Sanjay Kumar Mahajan during the course of cross-examination stated that the aforesaid injury could not have been caused had the injured Uttam Chand not raised his arm while walking. The High Court was of the view that PW-1 and PW-3 who were accompanying the deceased Uttam Chand at the relevant time had never stated that deceased Uttam Chand had at any point of time raised his arm while walking or on being challenged by the accused. It is the categorical statement of PW-1 Hans Raj and PW-3 Vijay Kumar that while they were accompanying the deceased, the accused had challenged the deceased and thereafter fired at him. It is but quite natural that the deceased when challenged would have reacted by raising his hands either in defence or in accepting the challenge and in the process he would have sustained injury No. 2, as described. The reaction of the deceased in raising his hands, in such circumstances, would be in tune and in consonance with the natural human behaviour in ordinary circumstances. There is not set of rule that one must react in a particular way. The natural reaction of man is unpredictable. Every one reacts in his own way. Such natural human behaviour is difficult to be proved by credible evidence. It has to be appreciated in the context of given facts and circumstances of each case.

Fifthly, the High Court was also of the view that PW-1 Hans Raj and PW-3 Vijay Kumar were accompanying the deceased and the prosecution story shows that the pellets from the gun shot had scattered and hit even the tree but the absence of injuries on the person of PW-1 and PW-3 render their presence at the place of occurrence doubtful. This finding of the High Court, in our opinion, is also fallacious and perverse. PW-1 and PW-3 had categorically stated that the deceased was walking ahead of them. The accused undisputedly nurtured a grudge against the deceased for alleged siding with the PW-5 Gian Chand, with whom the accused had civil dispute, challenged the deceased, the gun was aimed at and fired at him. It is, in these circumstances, the absence of pellet injuries on the persons of PW-1 and PW-3 will be no ground to render the presence of PW-1 and PW-3 at the place of occurrence doubtful.

The last and the most perverse and fallacious finding of the High Court is with regard to discarding the evidence of eye-witnesses account of PW-1 Hans Raj and PW-3 Vijay Kumar. The High Court recorded the finding as under:

"PW-1 Hans Raj is the real brother of the deceased, while PW-3, Vijay Kumar, apart from being a cousin brother of the deceased is the son of PW-5, Gian Chand, with whom admittedly the accused had litigation. It is the prosecution own case that the accused was nursing a grudge against the deceased and PW-1, since they were helping and siding with PW-5, Gian Chand. Both PW-1 and PW-3 are, therefore, interested witnesses and in view of the evidence coming on the record, cannot be safely relied upon."

As already noticed PW-1 Hans Raj and PW-3 Vijay Kumar are two eye-witnesses who accompanied the deceased on the fateful day. Both the eye-witnesses had stated categorically that they accompanied the deceased while going to the fields to fetch fodder for the cattle. When they were passing through the passage in front of the house of the accused, the accused challenged the deceased and in the meantime fired at him, with the result deceased Uttam Chand fell down on the ground after having sustained gun shot injuries on his person. The two eyewitnesses were subjected to lengthy cross-examination but nothing could be elicited to doubt the creditworthiness of their testimony. No doubt; that PW-1 and PW-3 are relatives but this will be no ground to disbelieve their testimony, if otherwise, inspired confidence. The law on the point is well-settled that the testimony of relative witness cannot be disbelieved on the ground of relationship. The only requirement is to be examine their testimony with caution. In the given facts of the case, it is but quite natural that the relatives would have accompanied the deceased to collect the fodder for the cattle from the fields at about 10.30 a.m. on the fateful day. It is also in the prosecution evidence that the incident at 10.30 a.m. is preceded by an altercation and quarrel between the accused Mast Ram and PW-5 Gian Chand, on the same morning at about 10.00 a.m. with regard to the disputed abadi and the deceased Uttam Chand is said to have intervened in the matter and advised both PW-5 Gian Chand and the accused Mast Ram not to quarrel and wait for the decision of the civil litigation. It is also in the evidence that thereupon the accused Mast Ram threatened the deceased Uttam Chand that he would deal with him first of all as he was siding with Gian Chand with whom the accused is having pending litigation with regard to abadi. The categorical testimony of eye-witnesses' account has not been considered and discussed at all by the High Court. Their testimony was thrown out at the threshold on the ground of animosity and relationship. This is not the requirement of the Law. That apart, PW-4. Tarsem Lal is an independent eye-witness. PW-4 also hails from the same village. He is neither related to the complainant party nor to the accused party. He has stated that he saw the accused Mast Ram in his verandah with a gun in his hand and also saw him running away from the spot after the gunfire. The High Court has not considered and discussed the testimony of PW-4 at all.

The testimony of PWs, 1, 3 and 4 was consistent with the report of ballistic expert and the evidence of PW-2 Dr. Sanjay Kumar Mahajan who conducted the post-mortem examination on the body of the deceased and found the following injuries:—

1. A circular area about 1 cm diameter on Antero-lateral surface of left arm about 9 inches from Acromion.

2. A circular area about 1.5 cm diameter in left Axilla toward left arm.
3. A circular area about 1 cm diameter on Anterior surface of left shoulder.
4. An area circular about 1.2 cm diameter about 3 cm below injury No.3.
5. A circular area of 1.3 cm diameter on medial wall of left axilla which is formed by chest wall. Tract has been formed on Probing:—3 inches of probe went inside.
6. A circular area of about 1.4 cm diameter in left Infra clavicular region 7 cm below mid clavicular point.
7. A circular area 1.2 cm diameter about 2.3 cm below injury No. 6.
8. An area 2 cm x 1 cm about 2 cm away from left nipple mediosuperior.
9. An area of 3.2 cm x 2.3 cm on sternum about 5 cm below sternal notch.
10. An area of 4.1 cm x 2.3 cm above left costal margin about 5 cm away from Xiphi-Sternum.
11. A circular area of 1 cm diameter on right side of sternum.
12. An area of 7.2 cm x 2.1 cm on right side of chest in Midline about 10 cms below mid clavicular point, widest in centre, tapering on periphery.
13. An area of 6.5 cm x 3.1 cm about 13 cm from medial end of eight clavicle.
14. An area of 15 cms diameter just below right nipple:—

On probing: No. 13 it came out of injury No. 14 though subcutaneous planer."

PW-2 Dr. Sanjay Kumar Mahajan, opined that all the injuries were ante-mortem having been sustained by a firearm like gun and such injuries were sufficient in the ordinary course of nature to cause death.

In our view, the consistent ocular testimony of PWs 1, 3 and 4 corroborated by the opinion of PW-2 Dr. Sanjay Kumar Mahajan and ballistic expert report clearly established the prosecution case beyond all reasonable doubts and the High Court fell into grave error of law and facts, resulting in grave miscarriage of justice.

For the foregoing reasons, the order of the High Court is set aside and the order of the trial Court is restored. The appeal is allowed. The bail bond of the respondent-accused Mast Ram is cancelled. He is directed to be taken back into custody forthwith. Compliance report within one month from today.

10.7 35 Years' Trial[1]

Facts

Bhanu Prakash Sharma (PW-1) was taking tea at Hamid Khan's Hotel at about 2.30 p.m. His brother Dharam Prakash (PW-3) arrived at the crossing towards Narora Bus Stand. Dharam Prakash aged about 18 years was a student

1. *Satyavir Singh* v. *State of Uttar Pradesh*, 2010 Cr LJ 1659 (SC).

of Khurja Polytechnic. Satyavir Singh, accused is the resident of village Niwari. Vijay Singh is his elder brother and owned a double barrel gun under a valid licence. It is the case of the prosecution that the fields of farmers in village Niwari were irrigated by tubewell of Prem Shankar Thakur. A road was constructed for the power house due to which some farmers of village Niwari started irrigating their fields from the tube well of Bhanu Prakash Sharma (PW-1), resident of village Jairampur Bangar. This caused some displeasure to Prem Shankar Thakur, father of Satyavir Singh, the accused. At about 2.30 p.m. on 9-2-1975 said Bhanu Pratap Sharma was taking tea in the Hotel of Hamid Khan at Chauraba of the village. Dharam Prakash came from the side of Narora Bus Stand. The accused on seeing Dharam Prakash, who ultimately examined as PW-3, challenged him by saying that how he was irrigating the fields of villagers from his tube-well. The accused, as already noticed, was armed with a licenced gun of his brother. The accused thereupon fired two bullets from that gun on Dharam Prakash. Dharam Prakash was medically examined on that very day by Dr. Suresh Chandra Singh (PW-5) and the following injuries were noticed on his person:

> 'INJ: (1) Lacerated wound 1 c.m. x 1 c.m. x thickness of (he left upper arm, on the left upper arm front aspect in upper part. There are four abrasions each '4 c.m. x ¼ c.m. on its lower and outer aspect. Suspected underneath Adv. X-ray. The margins of the wound are inverted.
>
> (2) Lacerated wound 1.5 c.m. x 1.5 c.m. x thickness of the left upper .. on the back aspect of the left upper arm 2 c.m. above the elbow... Suspected underneath. Adv. X-ray. The margins of the wound are inverted.
>
> (3) Lacerated wound 7.5 c.m. x 3.5 c.m. on the left forearm upper half inner aspect. It is bone deep. Suspected fracture underneath. Adv. X-ray.'

The occurrence was witnessed by Bhanu Prakash Sharma informant. Rama Shanker (PW-4); Brij Bhushan and others. Bhanu Prakash Sharma reported the matter to the police, the first information report was registered being Exh.Ka-1 at about 16.05 hours and the case under section 307 of the Code and under section 25 of the Act was registered against the accused. The accused was arrested. The accused was also medically examined on that very day and on his person the following injuries were noticed:

> 'INJ: (1) Swelling 5 c.m. x 5 c.m on the right side of front of face and nose. There is clotted blood in both nostrils. Red in colour. Adv. X-ray.
>
> (2) Swelling 2 c.m. x ½ c.m. on the left cheek lower jaw. Adv. X-ray in colour.
>
> (3) Abrasion 1/5 c.m. x 1/5 c.m. on the front of the right knee joint. Oozing stopped.'

Accused also lodged a report with Police Station, Dibai. District Bulandshahr on 9-2-1975 at about 5.00 p.m. stating that Pandit Raghunandan Prasad resident of village Jairampur Bangar had a tubewell in the village. Later on the appellant-accused installed a tube-well in his own village Niwari and started giving water for irrigation at lesser price. This affected the income of Pandit Raghunandan Prasad. On 9-2-1975 when he was carrying the gun of his brother Vijay Pal Singh

to Narora and reached at the shop of Hamid Khan situated in Village Jairampur Bangar, Bhanu Prakash. Dharam Prakash, Rama Shankar and other unknown person met him and started snatching his gun. The fire accident happened due to snatching and caused injuries to Dharam Prakash. The accused was beaten and his gun was snatched. This came to be registered as Criminal Case No. 27A/75; whereas on the complaint of PW-1, Criminal Case 87/75 under section 307 of the Code and section 25 of the Act respectively was registered.

Now we may proceed to examine the appreciation of evidence on record by the First Appellate Court acquitting the accused as well as that of the High Court reversing the judgment of acquittal.

The High Court noticed that the fields of farmers in village Niwari were irrigated from the tubewell of Prahlad Singh Thakur which was installed in that village. It was because of construction of the road for the Power House that the farmers of village Niwari started irrigating from the tubewell of Bhanu Prakash Sharma resident of Village Jairampur Bangar. This was not bearable to the accused who is the son of Prahlad Singh Thakur. Thus, this may not be exactly a motive but was a reason enough for the accused to take an offensive step against the injured.

The first information report was lodged by Bhanu Prakash Sharma without any delay and as already noticed Dharam Prakash (PW-3) had been challenged by the accused saying that how he was irrigating the fields of the villagers of his village from his tubewell Armed with a licensed gun of his brother, he opened fire on Dharam Prakash and shot two bullets. The occurrence was seen by Bhanu Prakash Sharma (PW-1), who was present there as well as Rama Shankar (PW-4) and some others. The accused was arrested and the gun was also deposited. Ext.Ka-1 report to the police station was lodged by Bhanu Prakash Sharma (PW-1).

Dharam Prakash was medically examined on 9th February, 1975 at about 4.35 p.m. and according to Dr. Suresh Chandra Singh (PW-5), three injuries were found on the person of the injured who was then subjected to X-Ray by Dr. A.K. Agarwal (PW-8), who was posted as Radiologist in District Hospital, Bulandshahr. It has been proved on record by Dr. Jitendra Singh Sharma (PW-7) that Dharam Prakash remained in the hospital from 9th February, 1975 to 20th March, 1975.

The medical evidence clearly reflected that the injuries could be caused by gun shots. However, there was little difference of opinion between two doctors but both these doctors are not the Ballistic Experts so as to provide any expert opinion which could safely be relied upon by the Court while deciding the case.

The difference of opinion between experts necessarily may not persuade the Court to adopt one approach or the other particularly when none of the experts are persons competent to express opinion on that subject. The difference of opinion between two doctors which, in the facts and circumstances of the present case, does not have any material bearing on the case of the prosecution is not such a formidable submission which has to be accepted by the Court to grant necessarily the benefit of doubt to the accused.

In the case of *Malay Kumar Ganguly* v. *Dr. Sukumar Mukherjee,* (2009) 9 SCC 22: 2010 AIR SCW 769, this Court has, while noticing the difference of opinion between the doctors on the basis of the evidence on record and the literature produced, preferred one view over the other without commenting on any expert opinion expressed by either of them.

It was stated by Dr. Suresh Chandra Singh (PW-5) that such injuries could be caused by gun shots. The trial court and the High Court expressed in unambiguous language the view that it was possible that no gun powder was traced around the wounds of the injuries as he was wearing clothes. This finding cannot be said to be erroneous. Dr. A.K. Agarwal (PW-8) clearly stated that the pellets of the fire shots were found in the wounds and were duly seen in the X-ray of the injured. Thus such view taken by the courts cannot be faulted. In fact the major part of the occurrence is not even disputed by the accused in his statement under section 313 of Cr. P.C. and in any case the report lodged by him bearing No. 27A/75 clearly shows that the incident occurred and the injured besides, other two witnesses, PW-1 and PW-2 were present at the spot. In fact according to the accused it was an accidental fire which occurred as a result of snatching of the gun by the injured and other persons accompanying him at that time. While, according to the prosecution he had fired two shots which injured the victim and thereafter the gun was snatched. Dr. Suresh Chandra Singh (PW-5) examined the injuries of the injured and stated that injuries would have been caused 2-3 hours earlier and that when the injured was brought to the hospital he was bleeding and such injuries could be sustained by gun shots. This statement of the doctor had fully supported the case of the prosecution and chain of events as stated therein.

With considerable emphasis, learned counsel for the appellant argued that as no explanation was rendered by the prosecution as to how the gun had broken, this would straightway cause serious dent in the case of the prosecution and entitles the accused for an acquittal.

We find no merit in the aforesaid contention. It was for the accused to prove his defence as the prosecution is liable to prove the case as stated in the first information report and the report filed by it under section 173 of Cr.P.C. The eye-witnesses had actually seen the victim being injured by the shots fired by the accused. In fact the accused was apprehended at the spot with the gun. The gun in question was admittedly a double barrel gun and the same was used by the accused while firing two shots. The gun with the spent cartridges were taken into custody *vide* Ext Ka-3. The accused himself had lodged the report bearing No. 27 A/75 under section 394 of the Indian Penal Code against the eye-witnesses including Bhanu Prakash Sharma. Dharam Prakash. Rama Shankar and one unknown person. The report lodged by the accused, itself shows as to how the gun was broken. But the breaking incident took place after the two shots had been fired by the accused upon the injured. There appears be no justifiable reason as to why the eye-witnesses PW-1 and PW-4, who even according to the accused were present at the place of occurrence, should be disbelieved. It could be safely construed from the evidence on record that the accused may not have been by strong motive to kill the victim, however, the loss of revenue on

account of the fact that water for irrigation was being provided by the father of the injured, was reason enough for the accused to show his anger or it was not acceptable to him, as stated by the witnesses, thus he fired two shots which resulted in causing injuries to Dharam Prakash. Both the reports were lodged by the informant as well as the accused at 2.30 p.m. on 9th February, 1975. The gun and the utilized bullets were given at the police station itself. This evidence clearly shows that prosecution has not failed in proving its case in accordance with law.

As already noticed, part of the occurrence stands admitted and it is only the limited aspect of the case as to whether the firing was accidental or the accused had intentionally fired on the injured. Statement of the eye-witnesses, medical evidence and the investigation conducted by the Investigating Officer clearly show that the prosecution has been able to prove its case beyond reasonable doubt. The act of firing gun shots at the injured obviously shows that the accused had the knowledge that by such an act he may even cause the death of the injured and actually caused hurt to victim. It is a matter of co-incidence that the gun shots did not injure Dharam Prakash at any of his vital organs.

Learned counsel appearing for the appellant while referring to certain discrepancies appearing in the statements of the witnesses including the doctors, vehemently contended that it was a case of acquittal and there was no intention on the part of the accused to kill the injured otherwise he would have fired the gun shots at the vital parts of the body of the injured, particularly when according to the prosecution, it is stated that the firing took place from a close distance. If that was so, such injuries would not have been caused. This contention also does not impress us inasmuch the tattooing and charring shall always depend upon the constituents of the propellant charge and it is in that context only wounds are classified by their external appearance as close contact. Reference can be made to *Bano Prasad* v. *State of Bihar*, (2006) 12 SCALE 354: 2007 AIR SCW 807.

Some discrepancies *per se* would not prove fatal to the case of the prosecution particularly when there is no reason before the Court to doubt the statement of the eye-witnesses, PW-1. There has been no delay in registration of the case and in fact even a counter case was registered which did not it in favourable culmination for the accused. It may also be noticed that the learned trial court as well as the High Court has referred to the statement of the accused recorded under section 313 of Cr. P.C. which to some extent falls in line with the case of the prosecution.

The cumulative effect of the above discussion is that we do not see any reason to interfere with the judgment of the High Court. The High Court has not exceeded its jurisdiction in law and with reference to the evidence on record while reversing the judgment of acquittal to one that of conviction. So far as the conviction of the accused under section 25(1) of the Act is concerned, no arguments were addressed. In any case we see no reason to interfere with the said finding of the courts below.

In the result, the appeal fails and is dismissed.

10.8 Judicial Overshooting[1]

One of the circumstance on the basis of which the appellant has been convicted by the trial Court is that the appellant has fired a shot from the 12 bore gun which has been recovered. This gun taken into possession and the empty cartridge recovered on the alleged statement of the appellant tallied and it has been approved by the report of the Ballistic expert.

At this stage, it would be relevant to notice the statement, made by the P.W. S.H. Bhukhari Scientific Officer, Ballistic FSL, Jammu, on cross-examination. He deposed as under:—

> *"On cross-examination, states that the empty cartridge, exhibit C1 was received by me in the laboratory in a wrapped cloth. There has not been mentioned any manufacturing date on the empty cartridge. For preserving the impression of the fired cartridge it should have been packed in cotton wool especially the head portion of the cartridge, but the fired cartridge received by me was not packed in cotton wool. I have not taken micro photographs of the test fired cartridge and used cartridge to compare the impression on them. The taking of the micro-photographs is mandatory for coming to the specific conclusion that particular cartridge has been fired from a particular gun. In my report Ext. P. 27, I have mentioned that used cartridge CI could have fired from the SBBL gun exhibit FI because maximum marks/impressions not tallied with the test fired cartridge. On the T-shirt which was marked by me as TSI/HI, I found only one hole. The diameter of the hole on the sit was 1 inch. To the question put by the defence counsel "What could have been distance in the present case from which the bullet was fixed". The witness replied that he cannot say with certainty without examining the dead body but, however, depending upon the colour concentration test, range of ire could be from close proximity. I cannot safi whether the injury suffered by the deceased could be self inflicted."*

A perusal of the above deposition made by the Ballistic expert shows that he has not given any specific opinion that the empty cartridge has been filed from the gun so recovered. He has specifically deposed that he did not conduct micro photograph of the test fired and used 'cartridge to compare the impression on them which is mandatory for coming to the conclusion that particular cartridge has been fired from a particular gun. It is very strange that the learned Sessions Judge has observed that the word "not" in the evidence of Ballistic expert during his cross-examination is a typographical mistake and should not have been recorded there. It be seen that the evidence was not recorded by the officer who has passed the order impugned of conviction of the appellant. The officer concerned who recorded the evidence has read over the same to the witness and both officer and witness have signed it. The word "were" occurring before the word "not" has been corrected. Therefore, if there would have been a mistake in recording the word "not", the officer concerned would have struck down the said word also but the same has not been done which shows that the word "not" figuring in the cross-examination of the Ballistic expert existed there and was not a typographical error.

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1. *Govind Singh* v. *State,* 2010 Cr LJ 585 (J&K).

A perusal of the observations made by the learned trial Court in this regard shows that the trial Court has created an evidence for the prosecution which is not the function of the Court. If there was any doubt with regard to existing or otherwise of the word "not" in the evidence given by the Ballistic expert in his cross-examination, then, the learned trial Court should have called the witness and made it clear whether he has stated so or not. If the word "not" was to be struck off, then, the defence had a right to cross-examine the witness on that point. But when the evidence has come on record and the witness and Presiding Officer has signed it, then, that part of evidence of the prosecution or defence cannot be read in any other way by observing that this is a clerical mistake. Therefore, as to why the learned trial Court has observed that this is a typographical error is not understandable.

The other circumstance relied upon by the learned trial Court is that the appellant has given a false explanation about the death of the deceased that he committed suicide, and, therefore, an adverse inference is to be drawn which also completes the chain of circumstance. In this regard, reliance has been placed by the learned trial Court on the judgment passed by the Apex Court in the case reported as AIR 1996 SC 2766: 1996 Cr LJ 4002: AIR 1992 SC 1175: 1992 Cr LJ 1529: AIR 2000 SC 571: 2000 Cr LJ 762: 2000 SCC (Cri) 263 and AIR 1967 Ori 118: 1967 Cr LJ 1155.

The judgments so referred to above, are not relevant to the facts of the present case. Instant is a case which is based on the eye-witness account, but the said witnesses, as noticed above, have not supported the case of the prosecution. The motive has not been proved. The recovery of the gun at the instance of the appellant has not been proved. The alleged confession made by the appellant in presence of P.Ws. Pawan Singh, Vishwa Nath and Mohd. Latif has also not been proved. It has further not been proved that the finger prints were taken in the presence of P.W. Pawan Singh, who is the independent witness. The circumstance taken into consideration by the learned trial Court that the appellant has given a false explanation can also not be accepted. If the accused takes a defence which is false and is not proved, then on the basis of that, the accused cannot be convicted. It is settled proposition of law that the prosecution has to stand on its own legs and cannot take the benefit of weakness of the defence. Therefore, mere taking a plea regarding false explanation by the appellant cannot be taken against him. Further, it has also not been proved that empty cartridge was recovered at the instance of the appellant from underneath the mattresses of the bed of his room. Despite all these facts, the learned trial Court has convicted the appellant and this has been done by mis-reading of the evidence.

10.9 Special Status for Injured Witness[1]

Regarding the argument of the counsel for the appellants that there is contradiction between the oral evidence and the medical records, we do not find any such inconsistency as alleged by the defence. Insofar as injury inflicted on the deceased Lala Mahto is concerned, no doubt PW-2 (Dr. C.P. Sinha) has stated that it seemed to have been caused by a sharp cutting weapon.

1. *Baleshwar Mahto* v. *State of Bihar*, AIR 2017 SC 873.

However, at the same time it is pointed out that injury in nature was one incised weapon 4 1/2 x1"x scalp bone deep on the right side of head injuring the right parital lob of brain laceration of this condex cells resulting to unconsciousness and paralysis of the left side of the body. It is significant to mention that he has further categorically stated that in his opinion such an injury could have been caused by rifle shot as well. Likewise, in the postmortem report also, it is stated that injury was ante-mortem which was incised wound of the same measurement and description as given in report of PW-2.

This post-mortem report further discloses that on dissection, it was found that skull was cut and fractured corresponding to the level of the injury and brain was lacerated by pieces of bone. Likewise, insofar as injuries which were found on the person of Bindeshwar Prasad, brother of PW-7 description thereof is as under:

"(i) One lacerated wound 1"x1"/4x1"/4 on the head internally.

(ii) Three lacerated wound of various sizes- sizes ranging 2 1/2" x 1/4 "x 1/4" to 1"x 1/4" x 1/4" on the back." No doubt, it is mentioned that the aforesaid injuries were simple in nature. However, the learned counsel for the appellants conveniently omitted to mention about the injuries inflicted upon PW-7 which according to PW-2 were as under:

"1. Multiple Pea sized gunshot wound (pellets) on the left scapular region of the back. 'All were superficial.'

2. One Pea sized pellet wound on the left side of head posterially. It was also superficial." These injuries are sufficient to rope in A-2 for offences under section 307, IPC. When we examine the matter in the aforesaid perspective we do not find any inconsistency between ocular evidence and the medical evidence. How medical evidence is to be collated with ocular evidence, is described by this Court in *Kamaljit Singh* v. *State of Punjab*[1] in the following fashion:

"8. It is trite law that minor variations between medical evidence and ocular evidence do not take away the primacy of the latter. Unless medical evidence in its term goes so far as to completely rule out all possibilities whatsoever of injuries taking place in the manner stated by the eyewitnesses, the testimony of the eyewitnesses cannot be thrown out. [See *Solanki Chimanbhai Ukabhai* v. *State of Gujarat,* (1983) 2 SCC 174: 1983 SCC (Cri) 379: AIR 1983 SC 484].

The position was illuminatingly and exhaustively reiterated in *State of Uttar Pradesh* v. *Krishna Gopal,* (1988) 4 SCC 302: 1988 SCC (Cri) 928: AIR 1988 SC 2154. When the acquittal by the trial court was found to be on the basis of unwarranted assumptions and manifestly erroneous appreciation of evidence by ignoring valuable and credible evidence resulting in serious and substantial miscarriage of justice, the High Court cannot in this case be found fault with for its well-merited interference." Here, PW-7 is also an injured witness. When the eye-witness is also an injured person, due credence to his version needs to be

1. (2003) 12 SCC 155.

accorded. On this aspect, we may refer to the following observations in *Abdul Sayeed* v. *State of Madhya Pradesh*:

> ***"28. The question of the weight to be attached to the evidence of a witness that was himself injured in the course of the occurrence has been extensively discussed by this Court. Where a witness to the occurrence has himself been injured in the incident, the testimony of such a witness is generally considered to be very reliable, as he is a witness that comes with a built-in guarantee of his presence at the scene of the crime and is unlikely to spare his actual assailant(s) in order to falsely implicate someone.***

"Convincing evidence is required to discredit an injured witness." [Vide *Ramlagan Singh* v. *State of Bihar,* (1973) 3 SCC 881: 1973 SCC (Cri) 563: AIR 1972 SC 2593; *Malkhan Singh* v. *State of Uttar Pradesh,* (1975) 3 SCC 311: 1974 SCC (Cri) 919: AIR 1975 SC 12; *Machhi Singh* v. *State of Punjab,* (1983) 3 SCC 470: 1983 SCC (Cri) 681; *Appabhai* v. *State of Gujarat,* 1988 Supp SCC 241: 1988 SCC (Cri) 559: AIR 1988 SC 696; *Bonkya* v. *State of Maharashtra,* (1995) 6 SCC 447: 1995 SCC (Cri) 1113; *Bhag Singh,* (1997) 7 SCC 712: 1997 SCC (Cri) 1163; *Mohar* v. *State of Uttar Pradesh,* (2002) 7 SCC 606: 2003 SCC (Cri) 121] (SCC p. 606b-c); *Dinesh Kumar* v. *State of Rajasthan,* (2008) 8 SCC 270: (2008) 3 SCC (Cri) 472; *Vishnu* v. *State of Rajasthan,* (2009) 10 SCC 477: (2010) 1 SCC (Cri) 302; *Annareddy Sambasiva Reddy* v. *State of Andhra Pradesh,* (2009) 12 SCC 546: (2010) 1 SCC (Cri) 630 and *Balraje* v. *State of Maharashtra,* (2010) 6 SCC 673: (2010) 3 SCC (Cri) 211] 29. While deciding this issue, a similar view was taken in *Jarnail Singh* v. *State of Punjab,* (2009) 9 SCC 719: (2010) 1 SCC (Cri) 107, where this Court reiterated the special evidentiary status accorded to the testimony of an injured accused and relying on its earlier judgments held as under: (SCC pp. 726-27, paras 28-29)

> "28. Darshan Singh (PW 4) was an injured witness. He had been examined by the doctor. His testimony could not be brushed aside lightly. He had given full details of the incident as he was present at the time when the assailants reached the tubewell. In *Shivalingappa Kallayanappa* v. *State of Karnataka,* 1994 Supp (3) SCC 235: 1994 SCC (Cri) 1694 this Court has held that the deposition of the injured witness should be relied upon unless there are strong grounds for rejection of his evidence on the basis of major contradictions and discrepancies, for the reason that his presence on the scene stands established in case it is proved that he suffered the injury during the said incident.
>
> 29. In *State of Uttar Pradesh* v. *Kishan Chand,* (2004) 7 SCC 629: 2004 SCC (Cri) 2021 a similar view has been reiterated observing that the testimony of a stamped witness has its own relevance and efficacy. The fact that the witness sustained injuries at the time and place of occurrence, lends support to his testimony that he was present during the occurrence. In case the injured witness is subjected to lengthy cross-examination and nothing can be elicited to discard his testimony, it should be relied upon [vide *Krishan* v. *State of Haryana,* (2006) 12 SCC 459: (2007) 2 SCC (Cri) 214]. Thus, we are of the considered opinion that evidence of Darshan Singh (PW 4) has rightly been relied upon by the courts below."

30. The law on the point can be summarised to the effect that the testimony of the injured witness is accorded a special status in law. This is as a consequence of the fact that the injury to the witness is an inbuilt guarantee of his presence at the scene of the crime and because the witness will not want to let his actual assailant go unpunished merely to falsely implicate a third party for the commission of the offence. Thus, the deposition of the injured witness should be relied upon unless there are strong grounds for rejection of his evidence on the basis of major contradictions and discrepancies therein." In this very judgment, relationship between the medical evidence and ocular evidence was also discussed, based on number of earlier precedents, as under:

"33. In *State of Haryana* v. *Bhagirath,* (1999) 5 SCC 96: 1999 SCC (Cri) 658 it was held as follows: (SCC p. 101, para 15)

"15. The opinion given by a medical witness need not be the last word on the subject. Such an opinion shall be tested by the court. If the opinion is bereft of logic or objectivity, the court is not obliged to go by that opinion. After all opinion is what is formed in the mind of a person regarding a fact situation. If one doctor forms one opinion and another doctor forms a different opinion on the same facts it is open to the Judge to adopt the view which is more objective or probable. Similarly if the opinion given by one doctor is not consistent with probability the court has no liability to go by that opinion merely because it is said by the doctor. Of course, due weight must be given to opinions given by persons who are experts in the particular subject."

34. Drawing on *Bhagirath* case, (1999) 5 SCC 96: 1999 SCC (Cri) 658, this Court has held that where the medical evidence is at variance with ocular evidence, "it has to be noted that it would be erroneous to accord undue primacy to the hypothetical answers of medical witnesses to exclude the eyewitnesses' account which had to be tested independently and not treated as the 'variable' keeping the medical evidence as the 'constant'".

35. Where the eyewitnesses' account is found credible and trustworthy, a medical opinion pointing to alternative possibilities cannot be accepted as conclusive. The eyewitnesses' account requires a careful independent assessment and evaluation for its credibility, which should not be adversely prejudged on the basis of any other evidence, including medical evidence, as the sole touchstone for the test of such credibility.

"21. ... The evidence must be tested for its inherent consistency and the inherent probability of the story; consistency with the account of other witnesses held to be creditworthy; consistency with the undisputed facts, the 'credit' of the witnesses; their performance in the witness box; their power of observation, etc. Then the probative value of such evidence becomes eligible to be put into the scales for a cumulative evaluation. [Vide *Thaman Kumar* v. *State (UT of Chandigarh),* (2003) 6 SCC 380: 2003 SCC (Cri) 1362 and *Krishnan* v. *State,* (2003) 7 SCC 56: 2003 SCC (Cri) 1577] at SCC pp. 62-63, para 21."

10.10 Shooting Homicide in Self-defence[1]

A. Private Defence

21. With regard to the evidence that the appellant was being assaulted and in fact attempted to be strangulated, it needs to be considered whether the appellant shot the deceased in the exercise of his right of private defence. Such a right is clearly available when there is a reasonable apprehension of receiving the injury.

22. The right of private defence is contemplated by section 97 of IPC which reads as follows:—

> *"Section 97. Right of private defence of the body and of property.*—Every person has a right, subject to the restrictions contained in section 99, to defend- First - His own body, and the body of any other person, against any offence affecting the human body; Secondly -The property, whether movable or immovable, of himself or of any other person, against any act which is an offence falling under the definition of theft, robbery, mischief or criminal trespass, or which is an attempt to commit theft, robbery, mischief or criminal trespass."

In *Darshan Singh* v. *State of Punjab*[2], this court laid down the following principles which emerged upon the careful consideration and scrutiny of a number of judgments as follows:—

> "58. The following principles emerge on scrutiny of the following judgments:
>
> 1. *Self-preservation is the basic human instinct and is duly recognised by the criminal jurisprudence of all civilised countries. All free, democratic and civilised countries recognise the right of private defence within certain reasonable limits.*
> 2. *The right of private defence is available only to one who is suddenly confronted with the necessity of averting an impending danger and not of self-creation.*
> 3. *A mere reasonable apprehension is enough to put the right of self- defence into operation. In other words, it is not necessary that there should be an actual commission of the offence in order to give rise to the right of private defence. It is enough if the accused apprehended that such an offence is contemplated and it is likely to be committed if the right of private defence is not exercised.*
> 4. *The right of private defence commences as soon as a reasonable apprehension arises and it is coterminous with the duration of such apprehension.*
> 5. *It is unrealistic to expect a person under assault to modulate his defence step by step with any arithmetical exactitude.*
> 6. *In private defence the force used by the accused ought not to be wholly disproportionate or much greater than necessary for protection of the person or property.*
> 7. *It is well settled that even if the accused does not plead self- defence, it is open to consider such a plea if the same arises from the material on record.*

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1. *Suresh Singhal* v. *State (Delhi Administration),* [Criminal Appeal No. 1548 of 2011]; S.A. Bobde, J. DOJ February 02, 2017.
2. (2010) 2 SCC 333.

8. *The accused need not prove the existence of the right of private defence beyond reasonable doubt.*
9. *The Penal Code confers the right of private defence only when that unlawful or wrongful act is an offence.*
10. *A person who is in imminent and reasonable danger of losing his life or limb may in exercise of self-defence inflict any harm even extending to death on his assailant either when the assault is attempted or directly threatened."*

23. Having regard to the above, we are of the view that the appellant reasonably apprehended a danger to his life when the deceased and his brothers started strangulating him after pushing him to the floor. As observed by this Court a mere reasonable apprehension is enough to put the right of self-defence into operation and it is not necessary that there should be an actual commission of the offence in order to give rise to the right of private defence. It is enough if the appellant apprehended that such an offence is contemplated and is likely to be committed if the right of private defence is not exercised.

24. It was argued by Mr. P.K. Dey, learned counsel for the State, that the deceased and his brothers were unarmed and there was no need for the appellant to have used the gun. Given the fact that the deceased and the others were attempting to strangulate the appellant, it would have been unrealistic to expect the appellant to "modulate his defence step by step with any arithmetical exactitude". This Court has held that a person who is in imminent and reasonable danger of losing his life or limb may in exercise of self-defence inflict any harm even extending to death on his assailant either when the assault is attempted or upon being directly threatened. We are inclined to think that the appellant had been put in such a position.

25. We have no doubt that the appellant exceeded the power given to him by law in order to defend himself but we are of the view that the exercise of the right was in good faith, in his own defence and without premeditation. In this regard, it would be apposite to reproduce the observation of Sessions Court which is as follows:—

> *"Since I feel that the prosecution witnesses are hiding something at the introduction stage of the story, I will not impute a prior concert or intention to the accused. I have no doubt that tempers got fayed at the spot itself and whatever happened was not a result of prior meeting of minds amongst the accused persons."*

26. The High Court has also observed as follows:—

> *"In the facts and circumstances of the case, we find it difficult to accept that the murder of Shyam Sunder and Kishan Lal had been preplanned. Had Suresh Singhal and his father late Pritpal Singhal preplanned the murder, they would have chosen some other place to execute their plan and would not have done it in the office of the informant, in the presence of a number of persons.*
>
> *The convict Suresh Singhal and his father late Pritpal Singhal knew that a number of persons including the informant Lala Harkishan Dass and the members of the Gurdaspur Party would be present in the office of the informant on that day and in the event of Krishan Lal and his brother(s) having murdered there,*

all these persons would be eye-witnesses against them. It is, therefore, highly unlikely that they would have planned to commit murders at that place.

It is true that both of them were armed with loaded revolvers when they came to the office of the informant on that day. But that in our view, in the facts and circumstances of the case, does not necessarily mean that they had preplanned the murder, though it does show that they were fully prepared to meet any eventuality and go to any extent including use of the firearms they were carrying with them."

27. The homicide in the present case thus does not amount to murder in the view of Exception 2 to section 300 of IPC[1]. We agree with the observations of the Sessions Court and the High Court that the homicide was not the result of premeditation but rather, as the evidence suggests, the shooting took place in a sudden fight in the heat of passion. It is not possible to accept the argument of the prosecution that the appellant took undue advantage of the situation and used the gun even though the deceased- Shyam Sunder and his brothers were unarmed. Given the murderous assault on the appellant and the possibility of being attacked again, may be with arms or may be with the help of the other persons, it is not possible to attribute undue advantage to have been taken by the appellant. In such a situation it would be unrealistic to expect the appellant to calmly assess who would have the upper hand before exercising his right of private defence.

28. In the circumstances of the case and the findings of the Sessions Court and the High Court, we find that the homicide falls within Exception 4 to section 300 of IPC[2] and does not amount to murder.

29. Mr. Sushil Kumar, the learned senior counsel for the appellant, argued that since the evidence states that the shot was fired from a distance and the deceased was on top of the appellant in the course of the scuffle during which he was being strangulated, the fatal shot could have only been fired by Pritpal Singhal. According to the learned counsel, he was the only other person who had a gun and had every reason to exercise the right of private defence to protect his son from strangulation.

30. It is not possible for us to accept the argument that merely because Pritpal Singhal had a gun, and that he could have used it to save his son, he fired the shot. There is no foundation in the evidence of any of the witnesses to suggest that Pritpal Singhal fired at the deceased-Shyam Sunder from any place in the room to save his son. Even otherwise, shooting at two people grappling on the floor would have been a risk since the shot could have injured either or both persons. It is therefore, not possible for us to accept this submission.

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1. "*Exception 2*.—Culpable homicide is not murder if the offender, in the exercise in good faith of the right of private defence of person or property, exceeds the power given to him by law and causes the death of the person against whom he is exercising such right of defence without premeditation, and without any intention of doing more harm than is necessary for the purpose of such defence."
2. "*Exception 4*.—Culpable homicide is not murder if it is committed without premeditation in a sudden fight in the heat of passion upon a sudden quarrel and without the offender's having taken undue advantage or acted in a cruel or unusual manner."

31. The strong possibility is that there was a scuffle in which the appellant was pinned to the floor and attempted to be strangulated by the deceased. The appellant may have pulled out his gun and upon seeing the gun, the deceased may have released the appellant and started running upon which the appellant fired the shot which hit him from the back side. This also explains the trajectory of the shot in which the bullet entered the body below the right shoulder, and travelled upwards without exiting.

32. In these circumstances, we are of the view that Suresh Singhal is undoubtedly guilty of causing death to Shyam Sunder with the intention of causing death or of causing such bodily injury as is likely to cause death and therefore guilty of the offence under section 304 of the IPC. We are informed that the appellant has already undergone a sentence of 13½ years as on date. We thus sentence him to the period already undergone.

B. Kishan Lal's Death

33. The appellant has also been convicted under section 302 IPC for the murder of Kishan Lal. Hans Raj (PW-3) deposed that the appellant fired at his brother, and when he (PW-3) and his brothers-Raj Kumar and Kishan Lal, tried to catch hold of the appellant, the appellant told his father to finish all the brothers. He then stated that Pritpal Singhal took out a revolver from his pocket and both the appellant and his father started firing at him and his brother-Kishan Lal. He stated that he received two bullets on his stomach, and one bullet grazed him over the neck portion in the front. When he started running out, he was hit by another bullet on the back of his right shoulder.

34. When he and Kishan Lal started running out, he heard Pritpal Singhal tell Roshan Lal to go outside, get the gun from the vehicle and that the fourth brother should not be spared.

35. It may be remembered that this witness survived the shooting with two bullets still lodged in his body. The office in which the firing took place was a small area. Yet this witness does not specify that the appellant shot him. He generally states that appellant and his father started firing at him and his brothers. Thus, it is difficult to say with certainty that the shots which hit Kishan Lal were fired by Suresh Singhal.

36. In these circumstances all that can be said is that a shot from the appellant may have hit Kishan Lal or may not have hit Kishan Lal. This benefit of doubt in law must go to the appellant.

37. For the reasons stated above specifically that Hans Raj (PW-3) did not specify that the appellant shot him. There is a serious doubt whether it can be held as having been proved beyond reasonable doubt that the appellant attempted to murder Hans Raj for which he has been convicted.

38. It is not possible for us to approve the observation of the High Court that because Suresh Singhal and Pritpal Singhal were armed "it is only the appellant and/or his father late Pritpal Singhal who could be responsible for the firing resulting in the murder of late Kishan Lal and the deceased-Shyam Sunder.

39. We have already held that the appellant killed the deceased in the exercise of the right of private defence. Pritpal Singhal may or may not have acted out of the desire to protect Suresh. He did not share the same intention as

that of Suresh. It is not possible to attribute common intention to kill the three brothers to both the appellant and his father.

40. Hence, we allow this appeal partly and modify the impugned judgment and order passed by the High Court to the extent that the conviction of the appellant – Suresh Singhal under section 302 IPC for murder of Kishan Lal is set aside and his conviction under section 304 IPC is maintained. Since the appellant has already undergone a sentence of 13½ years as on date, we sentence him under section 304 IPC to the period already undergone. The appellant is in jail. He be released forthwith from the custody, if not required in any other case.

10.11 Medical and Forensic Evidence Support the ocular Accounts[1]

The broad facts leading to the decision of the High Court are that on 19th June, 2004 at about 9.30 p.m. Nand Singh hadgone to Bathra Telecom & Restaurant at Nimbahera, District Pratapgarh in Rajasthan. He was accompanied by his friends Nitin Sindhi (accused No. 3) and Narendra Kumawat. While they were seated in the restaurant, Javed Beg (accused No.2) and Daud Khan (accused No. 1) came there on a motor cycle. It appears that Javed Beg and Daud Khan had some grudge against Nand Singh concerning the result of a cricket match between India and Pakistan.

3. According to the prosecution, Javed Beg brandished aknife and told Nand Singh that today his end had come. Thereupon Daud Khan fired upon Nand Singh with a loaded pistol on the right side of his chest and then both of them escaped on their motor cycle. It was also contended that the mere recovery of a pistol (from Javed) was not enough to hold Daud Khan guilty. In any event, the opinion of the Forensic Science Laboratory (FSL) was not definite that the bullet taken out from the body of Nand Singh was fired from the recovered pistol. Additionally, it was argued that according to the witnesses, the shot had been fired from a close distance but the post mortem report did not indicate any blackening of the skin which would have happened had the shot been fired from a close range. It was sought to be suggested that the eye witnesses were perhaps not present when the incident occurred and a story was made up to involve Daud Khan. The Trial Court accepted the recovery of the pistol, as well as unused cartridges, from Javed at the instance of Daud Khan. The Trial Court also took the view that the FSL report clearly stated that a bullet had been fired from the pistol and it was not stated that the bullet taken out from the body of Nand Singh could not have been fired from the recovered pistol. The Trial Court also held that Nand Singh's skin was not blackened since he was wearing a vest and a shirt. Therefore, fully believing the version of the eye witnesses, it was held that Daud Khan shot Nand Singh at the place of occurrence and there were several witnesses present at that time. On this basis, the Trial Court convicted Daud Khan of an offence punishable under section 302 of the IPC.

Procedure for investigation.—

(1) If, from information received or otherwise, an officer in charge of a police station has reason to suspect the commission of an offence

1. *State of Rajasthan* v. *Daud Khan*, Supreme Court, Criminal Appeal No. 126 of 2010: Source: JUDIS.

which he is empowered under section 156 to investigate, he shall forthwith send a report of the same to a Magistrate empowered to take cognizance of such offence upon a police report and shall proceed in person, or shall depute one of his subordinate officers not being below such rank as the State Government may, by general or special order, prescribe in this behalf, to proceed, to the spot, to investigate the facts and circumstances of the case, and, if necessary, to take measures for the discovery and arrest of the offender:

Provided that—

(a) when information as to the commission of any such offence is given against any person by name and the case is not of a serious nature, the officer in charge of a police station need not proceed in person or depute a subordinate officer to make an investigation on the spot,

(b) if it appears to the officer in charge of a police station that there is no sufficient ground for entering on an investigation, he shall not investigate the case:

Provided further that in relation to an offence of rape, the recording of statement of the victim shall be conducted at the residence of the victim or in the place of her choice and as far as practicable by a woman police officer in the presence of her parents or guardian or near relatives or social worker of the locality.

(2) In each of the cases mentioned in clauses (a) and (b) of the proviso to sub-section (1), the officer in charge of the police station shall state in his report his reasons for not fully complying with the requirements of that sub-section, and, in the case mentioned in clause (b) of the said proviso, the officer shall also forthwith notify to the informant, if any, in such manner as may be prescribed by the State Government, the fact that he will not investigate the case or cause it to be investigated.

Ballistics report: Submissions and discussion

30. It was vehemently contended that the report of the FSL (Exhibit P-37) did not conclusively say that the bullet recovered from the body of Nand Singh was fired from the pistol recovered from Javed at the instance of Daud Khan. The FSL report reads as follows:

"1. One .32 country made revolver (W/1) from packet 'E' in (is) a serviceable firearm. However, it has the tendency to misfire the ammunition.

2. The examination of the barrel residue indicates that submitted one .32 country made revolver (W/1) had been fired. However, the definite time of its last fire could not be ascertained.

3. Based on the stereo and microscopic examination, it is the opinion that it has not been possible to link definitely one 7.65 mm cartridge case (C/1) from packet 'E' and one .32 copper jacket bullet (B/1) from packet 'D' with submitted one .32 revolver (W/1) from packet 'E' due to lack of sufficient evidence."

31. A perusal of the FSL report suggests that it is not conclusive one way or the other whether the bullet extracted from the body of Nand Singh had or had not been fired from the pistol recovered from Javed at the instance of Daud Khan. In view of this, learned counsel placed reliance on *Mohinder Singh* v. *The State*. The facts of that case were quite unique.

In this context, this Court observed as follows:

> *"In a case where death is due to injuries or wounds caused by a lethal weapon, it has always been considered to be the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the weapon with which and in the manner in which they are alleged to have been caused. It is elementary that where the prosecution has a definite or positive case, it must prove the whole of that case. In the present case, it is doubtful whether the injuries which are attributed to the appellant [Mohinder Singh] were caused by a gun or by a rifle. Indeed, it seems more likely that they were caused by a rifle than by a gun, and yet the case for the prosecution is that the appellant was armed with a gun, and, in his examination, it was definitely put to him that he was armed with the gun P-16. It is only by the evidence of a duly qualified expert that it could have ascertained whether the injuries attributed to the appellant were caused by a gun or by a rifle and such evidence alone could settle the controversy as to whether they could possibly have been caused by a fire-arm being used at such a close range as is suggested in the evidence."*

In this case there is no such conflict. There is no doubt both from the medical and the ocular evidence that Daud Khan had shot with a gun. The forensic evidence shows that the bullet extracted from the body of Nand Singh was capable of being fired from the recovered gun. Whether Nand Singh was shot by use of the recovered gun or some other gun was not questioned and none of the witnesses was asked any substantive question about the gun recovered from Javed at the instance of Daud Khan or whether it was the same gun (or a different one) used by Daud Khan.

Blackening of the skin: Submissions and discussion

35. It was contended that since Nand Singh was shot from a close distance, there would have some blackening of his skin, but the post mortem report did not show any such blackening. It was contended, on this basis, that Nand Singh was actually shot elsewhere (where he collapsed) and not at the place suggested by the prosecution. PW-11 Narendra Kumawat who had accompanied Nand Singh and was with him when the incident occurred stated that Daud Khan had fired from a distance of about two feet. Similarly, PW-19 Suraj Mal stated that the bullet was fired from a distance of two feet, while PW-7 Mahabir Singh stated that the bullet was fired from a distance of one foot. PW-23 Narender Singh stated that the bullet was fired from a distance of 'four fingers and the bullet was not fired touching the pistol to the chest.' Finally, PW-24 Rishi Raj Shekhawat stated that "Fire was not made after touching the chest of Nand Singh, rather it was fired from the distance of one or two feet."

Therefore, each of the eyewitnesses stated that the shot was fired by Daud Khan at Nand Singh from very close quarters and in any event from a distance

of two feet or less. The High Court found, incorrectly, that the witnesses had testified that the shooting had occurred from nearby but no distance was mentioned by any witness.

37. Be that as it may, at this stage, reference may be made to Modi's Medical Jurisprudence and Toxicology (22nd Edition, page 354) wherein it is noted, with reference to blackening of the skin in a gunshot wound, as follows:

> *"If a firearm is discharged very close to the body or in actual contact, subcutaneous tissues over an area of two or three inches round the wound of entrance are lacerated and the surrounding skin is usually scorched and blackened by smoke and tattoed with unburnt grains of gunpowder or smokeless propellant powder. The adjacent hairs are singed, and the clothes covering the part are burnt by the flame. If the powder is smokeless, there may be a greyish or white deposit on the skin around the wound. If the area is photographed by infrared light, a smoke halo round the wound may be clearly noticed. Blackening is found, if a firearm like a shotgun is discharged from a distance of not more than three feet and a revolver or a pistol discharged within about two feet."*

38. Under the circumstances, in all likelihood if Nand Singh was, in fact, shot at from a close range of about two feet or less, there would have been some blackening of his skin. The Trial Court acknowledged this but was of the opinion that since Nand Singh was wearing a vest and a shirt (Exhibit P-6) his skin was perhaps prevented from being blackened by the gunshot wound. That may be so, but there is no evidence, one way or the other, that the vest and shirt of Nand Singh were blackened or not, nor was any question asked of any witness in this regard[1]. Therefore, we have no reason to dispute the conclusion of the Trial Court. 20 (2010) 6 SCC 1, On a consideration of the entire material before us, we have no hesitation in upholding the view taken by the High Court with regard to the offence committed by Daud Khan and his conviction for that offence. We see no substance in the appeal filed by the State and find no reason to reverse the conclusions arrived at by the High Court with regard to the offence committed by Daud Khan.

10.12 Shoddy (or Biased?) Investigations[2]

According to the case of the prosecution, on March 19, 1998, when the informant (PW-8) was in his juice shop, the appellant-accused, along with 3 (three) others, visited the shop. When Raj Kumar (since deceased) – elder brother of the informant came to the shop, Pankaj called him inside and opened fire at him using a country made pistol which hit him on his neck. Raj Kumar fell down on the ground and PW-8 took him to the hospital at Bharatpur. He succumbed to his injuries on March 25, 1998 at Agra.

The appellant-accused, along with others, was convicted by the Court of Additional District and Sessions Judge, (Fast Track), Bharatpur under sections 302 read with 34 of the IPC and under section 3 read with section 25 of the Arms Act. In appeal before the High Court, the conviction and sentence of

1. The firearm used in this case was pistol, a handgun. The target, usually, do not register powder marks beyond a few inches with such firearms. **(Author's Note)**
2. *Pankaj* v. *State of Rajasthan,* AIR 2016 SC 4150.

the appellant-accused was maintained while the other accused persons were acquitted of all the charges.

Dr. Vanay Singh (PW-6) is the person who examined Raj Kumar at the General Hospital, Bharatpur. It is imperative to mention here some of the portion of his statement which is as under:—

> *"…when killer and object, i.e., injured person both remains on the right angle, i.e., just in front of each other, then it is possible, as there was no burning, plunging and tattooing as such. As per rule of thumb of fire arms the distance was more than 3 feet. The exact distance can be decided only by the opinion of the plastic expert."*
>
> *"It is correct that if the injured is in front of the killer and who caused a injury by a fire arm in the neck of injured from a distance of 2 feet. Then the wound would not come in the shape of as shown in Exh. P-5. As per Rule of thumb, the fire made from maximum, nearest place, the entrance would will be big, then the exit wound and as distance will be increased the entrance wound become smaller then the exit wound, it means part of foreign body came out from a fire arm, as the distance will increase the passage of foreign body will be spread and will cause more loss in the nearby area…"*

Prior to his death, injury received by Raj Kumar was examined which reads as under:—

(1) One punctured lacerated wound with bleeding circular in shape of 1cm x 1cm x soft tissue to bone deep on right side neck region on sterno mastoid muscle line to middle part.

(2) Edges and margin inverted with color of contusion.

(3) No burning, blackening and tattooing seen, sulgesmic of wound of entry of fire arm.

As per the post mortem report, drawn by Dr. B.B. Sharma, (PW-7), the cause of the death was shock and hemorrhage due to ante-mortem injuries. Admittedly, there is variance in the statements of PW-8 and PW-6 with regard to the distance between the deceased and the appellant-accused as stated above. In this fact situation, it is imperative to quote the Phenomena observed in Firearm Injuries or Short Holes on Clothing", from Modi's Jurisprudence (24th Edition) which is as under:—

Phenomena[1]	**Range and Remarks**
1. Flame/burning scorching/singeing.	
a. Revolver/pistols	within about 5-8 cm generally
b. Rifles	within about 15-20 cm generally
c. Shotguns	may show of scorching upto 30-10 cm
2. Smoke/powder marks	
a. Rifles generally upto about 30 cm; (blackening) and (powder residues) about 100 cm	
b. Handguns up to about 60 cm	

1. The data given in Modi's book is for standard firearms. The data is not relevant to improvised firearm, like the one used in this case. Such firearms behaviour behave erratically and thus mislead. It is unfortunate that the fact was not brought to the notice of the honourable court. **(Author's Note).**

3. Tattooing

a. Handguns	up to about 60 cm
b. Rifles	up to 75 cm generally
c. Shotguns	up to 100-300 m (may

In a case where death is due to injuries or wounds caused by a lethal weapon, it is always the duty of the prosecution to prove by expert evidence that it was likely or at least possible for the injuries to have been caused with the weapon with which and in the manner in which they are alleged to have been caused. In the case on hand, the contradiction, *i.e.*, the distance of fire, is material and in our considered opinion, it would not be appropriate to convict the appellant-accused by ignoring such an important aspect.

An objection was raised by learned senior counsel for the appellant-accused that recovery of fire arm at the instance of appellant-accused was planted by the police and it could not have been relied upon.

This Court, in a number of cases, has held that the evidence of circumstance simplicitor that an accused led a police officer and pointed out the place where weapon was found hidden, would be admissible as conduct under section 8 of the Evidence Act, irrespective of whether any statement made by him contemporaneously with or antecedent to such conduct falls within the purview of section 27 of the Evidence Act.

In the above backdrop, it would be appropriate to quote the Forensic Report dated 25.06.1999 with regard to the alleged recovery of the country-made pistol recovered at the behest of the appellant-accused which is as under:—

"Result of Examination:

1. *One .32 country made pistol (W/1) from packet 'D' is a serviceable firearm.*
2. *The examination of the barrel residue indicates that submitted .32 country made pistol (W/1) had been fired. However, the definite time of its last fire could not be ascertained.*
3. *Based on stereo and comparison microscopic examination it is the opinion that one .32 lead bullet (B/1) from packet 'C' has not been fired from submitted .32 country made pistol "(W/1)."*

It is clear from the above that there is no material on record to connect that the gunshot injury suffered by the deceased was due to the shot fired from the firearm of the appellant-accused. It is also discernible that though the bullet was recovered but the same has not been connected with the weapon.

(13) It is a well-settled principle of law that when the genesis and the manner of the incident is doubtful, the accused cannot be convicted. Inasmuch as the prosecution has failed to establish the circumstances in which the appellant was alleged to have fired at the deceased, the entire story deserves to be rejected. When the evidence produced by the prosecution has neither quality nor credibility, it would be unsafe to rest conviction upon such evidence. After having considered the matter thoughtfully, we find that the evidence on record in the case is not sufficient to bring home the guilt of the appellant. In such circumstances, the appellant is entitled to the benefit of doubt.

10.13 Absence of Blackening[1]

Filtering the unnecessary details, the facts, which are necessary to be adumbrated for the adjudication of the instant appeals are that there was enmity between the accused, Dharam Pal and his family on the one side and Charan Singh, PW-1, on the other. Charan Singh, PW-1, Gajpal, PW-2, Tedha, PW-3 and Nepal Singh belong to village Dastoi, to which the deceased, Badan Pal, the nephew of Charan Singh as well as the accused persons belong. As the prosecution story further unfurls, sometime prior to the occurrence, Gaje Singh, brother of the accused, Dharam Pal, was murdered and Charan Singh, PW-1, along with others had faced trial for his murder and eventually got acquitted. The occurrence leading to the murder of Badan Pal took place in the evening hours of 26.03.1979.

Badan Pal was a student and he used to stay overnight at his tube-well which had a shed in the jungle of village Sarva. On the date of occurrence, he was at the aforesaid tube-well. Gajpal, PW-2, and Nepal Singh in the fateful evening while carrying the meals for Badan Pal, on their way, met Tedha, PW-3, who wanted to irrigate his fields from the aforesaid tube-well. All of them reached near the said tube-well about 7.30 p.m. when they heard the sound of a gun fire from inside the "kotha" (shed) of the said tube-well. They reached the place without loss of any time and noticed that all the four accused, namely, Dhani Ram, Dharam Pal, Mahendra and Vijendra, came out of that "kotha". Dhani Ram and Dharam Pal carried pistols, Vijendra was armed with a ballam and Mahendra carried a lathi. On seeing them, they took to their heels. After they reached the place, they found Badan Pal lying dead with bleeding wounds. The aforesaid witnesses identified the accused persons in the light of the electric bulb fixed on the roof of the tube-well as well as in the torch light. A report of the occurrence was prepared by Devendra Singh with the assistance of Charan Singh, PW-1, and was filed at Police Station Kharkhauda.

After the criminal law was set in motion, the investigation was conducted by S.I. Rajveer Singh, PW-8, who after recording the statements of some of the witnesses under section 161 CrPC between 6 a.m. to 8 a.m. on the next day, prepared the panchanama and the sketch map of the spot and collected blood stained and unstained earth as well as two cartridges. These were sealed on the spot and the dead body was sent for postmortem.

As per the medical evidence there is only one gunshot injury attributed to pistol supposedly in the hands of Dhani Ram and Dharam Pal (both since dead). None of the injuries on the person of the deceased could be attributed to lathi and ballam, which were carried by the present appellants and, therefore, they cannot be made liable for the offence.

Referring to the testimony of PW-6, Dr. M.C. Varshney, it is put forth that the said witness has stated that there was no blackening and scorching at the gunshot wound and that belies the prosecution version that the deceased died of gunshot injury.

1. *Vijendra Singh* v. *State of Uttar Pradesh*, AIR 2017 SC 860.

When the evidence in its entirety is studiedly scrutinized, it clearly shows that the accused persons were present in the shed, they were seen going away and the deceased was found lying in a pool of blood. The witnesses specifically stated about the weapons being carried by the accused persons. The submission is that the prosecution story rests on the gun shot injury but there is no evidence with regard to injury caused by the lathi or ballam. It is relevant to state here that cartridges from the spot have been recovered and PW-6 Doctor who conducted the post-mortem had found gunshot wound of entry eight in number in an area of 6 cm x 5 cm on the right side of neck just above the clavicle and lower part of neck. The dimensions of the wound ranged from 1 cm x 0.15 cm to 0.5 cm x 0.5 cm x bone deep.

There was no blackening or scorching around the wound. True it is that the doctor has stated that there is no blackening or scorching around the wound, but that will not belie that the injury was not inflicted by the firing from the gun. He has opined that the death of the deceased was caused by gunshot injury.

10.14 Evidence of Close relatives[1]

Per contra, Shri D.K. Goswami, learned counsel appearing for the State has vehemently opposed the appeal contending that the FIR had promptly been lodged within a period of 3 hours after mid-night though the police station was at a distance of 3 miles from the place of occurrence. The appellants had been named in the FIR. Roles attributed to each of them had been explained. Motive had also been mentioned. Injuries suffered by Tarawati and Chandra Bose had also been given. Law does not proscribe reliance upon the evidence of closely related witnesses.

However, it requires that evidence of such witnesses must be appreciated with care and caution. Once the evidence is found reliable/trustworthy, it cannot be discarded merely on the ground that the witness has been closely related to the victim. The injuries found on the person of the deceased as well as on Tarawati, Chandra Bose and Mohd. Shafi corroborate the case of the prosecution and in such a fact-situation, the provisions of section 149 IPC have rightly been applied.

The issue of non-examination of the injured witnesses, namely, Tarawati and Chandra Bose and of eye-witnesses, namely, Roshan Singh, Hukum Singh and Jagdish has not been put to the Investigating Officer in cross-examination who could have furnished the explanation for their non-examination. Thus, the issue cannot be raised first time in appeal before this Court. The appeal lacks merit and is liable to be dismissed[2].

10.15 Site of the injury and Motive[3]

State is aggrieved by the order of the High Court dated 13.12.2011, passed in CRLA No. 898 of 2007, reducing the sentence awarded by the trial Court from three years Rigorous Imprisonment with a fine of Rs. 1,000 to each of the accused persons, with default clause, to that of the period already undergone.

Respondents herein were charge-sheeted for the offences punishable under sections 294, 307 read with section 34, IPC and were convicted and sentenced

1. *Onkar* v. *State of Uttar Pradesh,* 2012 Cr LJ 1446: (2012) 2 SCC 273.
2. Also see: *Dahari* v. *State of Uttar Pradesh,* AIR 2013 SC 308.
3. *State of Madhya Pradesh* v. *Mohan,* AIR 2013 SC 3521.

as stated above. The incident leading to the above charges occurred on 11.6.2006 at 11.00 O'clock in the night when complainants attempted to drive away the animals of the accused persons trespassed into their courtyard. Accused persons, infuriated by the conduct of the complainants, reached the spot of the incident and started abusing them. One of the accused, Ummed Singh, using his firearm, fired a gunshot, which hit Lalaram, one of the complainants on his back and the complainant including Lalaram in order to save their lives ran away from the spot. Ummed Singh again fired another gunshot, which hit Mogh Singh, another complainant. Due to the injuries sustained by Lalaram, he fell down. The accused persons committed the same in furtherance of their common intention or knowledge that their actions would result in causing death to the complainants.

PW14, the doctor, has explained the nature of injuries and use of the firearm for causing the injuries. Firearm, it is proved, was used repeatedly against the complainants, causing bodily hurt.

This Court had occasion to consider the scope of section 307, IPC in *Sadha Singh* v. *State of Punjab,* (1985) 3 SCC 225, wherein the trial Court awarded the substantive sentence of three years of rigorous imprisonment and also imposed a fine, which were reduced by the High Court to a period of three months of imprisonment already undergone by the accused, but by enhancing the fine. This Court held that the reduction of the sentence was not justified.

In that case also, the doctor opined that the injuries were caused by firearm, just like the present case. This Court, reversing the judgment of the High Court and upholding that of the trial Court, held as follows:

> *"8. If the learned Judge had in mind the provisions of section 360 of CrPC so as to extend the benefit of treatment reserved for first offenders, these appellants hardly deserve the same. Admittedly, both the appellants were above the age of 21 years on the date of committing the offence. They have wielded dangerous weapons like firearms. Four shots were fired. The only fortunate part of the occurrence is that the victim escaped death. The offence committed by the appellants is proved to be one under section 307 of IPC punishable with imprisonment for life. We were told that the appellants had hardly suffered imprisonment for three months. If the offence is under section 307 IPC i.e. attempt to commit murder which is punishable with imprisonment for life and the sentence to be awarded is imprisonment for three months, it is better not to award substantive sentence as it makes mockery of justice."*

High Court was of opinion that injuries has not been caused on vital parts of the body. In order to attract section 307, the injury need not be on the vital parts of the body. In order to attract section 307, causing of hurt is sufficient. If anybody does any act with intention or knowledge that by his act he might cause death and hurt is caused, that is sufficient to attract life imprisonment. Section 307 uses the word 'hurt', which has been explained in section 319, IPC and not "grievous hurt" within the meaning of section 320, IPC. Therefore, in order to attract section 307, the injury need not be on the vital part of the body. A gunshot, as in the present case, may miss the vital part of the body, may result

in a lacerated wound, that itself is sufficient to attract section 307. High Court is, therefore, in error in reducing the sentence, holding that the injury was not on the vital part of the body. Period undergone by way of sentence also in our view is not commensurate with the guilt established.

17. We also have to remind ourselves the object and purpose of imposing adequate sentence. Reference may be made to the judgment of this Court in *State of Madhya Pradesh* v. *Saleem @ Chamaru*, AIR 2005 SC 3996.

> *"8. The object should be to protect the society and to deter the criminal in achieving the avowed object of law by imposing appropriate sentence. It is expected that the Courts would operate the sentencing system so as to impose "'such sentence which reflects the conscience of the society and the sentencing process has to be stern where it should be.*
>
> *9. Imposition of sentence without considering its effect on the social order in many cases may be in reality a futile exercise. The social impact of the crime, e.g. where it relates to offences against women, dacoity, kidnapping, misappropriation of public money, treason and other offences involving moral turpitude or moral delinquency which have great impact on social order, and public interest, cannot be lost sight of and per se require exemplary treatment. Any liberal attitude by imposing meager sentences or taking too sympathetic view merely on account of lapse of time in respect of such offences will be result-wise counterproductive in the long run and against societal interest which needs to be cared for and strengthened by string of deterrence inbuilt in the sentencing system."*

We, therefore, find no good reason to interfere with the judgment of the trial court. Consequently, the appeal is allowed and judgment of the High Court reducing the sentence is set aside and the judgment and order of the trial Court are restored.

10.16 Injured Eyewitnesses[1]

(i) The submission was that it was not a pre-meditated act but both the parties got raged due to the aforesaid dispute about the ownership of the plots. A-1, therefore, could not be convicted of committing murder and punished under section 302 of IPC, more so, when accused party also got injured in the said fight.

(ii) It was further submitted that the medical evidence by the doctors who examined PW-7, his brother as well as his father was at variance with the ocular evidence *i.e.* the description of the incident as given by the PW-7. In this behalf, it was submitted that PW-2, Dr. C.P. Sinha, who had examined Bindeshwar Prasad, brother of PW-7, found that the injuries were caused by hard fluid substances and was simple in nature. The same medical evidence was also referred to in respect of father of PW-7 which showed only one incised wound which according to PW-2 was caused by a sharp cutting weapon. Here, PW-7 is also an injured witness. When the eye-witness is also an injured person, due credence to his version needs to be accorded. On this aspect, we may refer to the following observations in *Abdul Sayeed* v. *State of Madhya Pradesh,* (2010) 10 SCC 259:

1. *Baleshwar Mahto* v. *State of Bihar,* AIR 2017 SC 873.

"28. The question of the weight to be attached to the evidence of a witness that was himself injured in the course of the occurrence has been extensively discussed by this Court. Where a witness to the occurrence has himself been injured in the incident, the testimony of such a witness is generally considered to be very reliable, as he is a witness that comes with a built-in guarantee of his presence at the scene of the crime and is unlikely to spare his actual assailant(s) in order to falsely implicate someone.

"Convincing evidence is required to discredit an injured witness." [Vide *Ramlagan Singh* v. *State of Bihar,* (1973) 3 SCC 881: 1973 SCC (Cri) 563: AIR 1972 SC 2593; *Malkhan Singh* v. *State of Uttar Pradesh,* (1975) 3 SCC 311: 1974 SCC (Cri) 919: AIR 1975 SC 12; *Machhi Singh* v. *State of Punjab,* (1983) 3 SCC 470: 1983 SCC (Cri) 681; *Appabhai* v. *State of Gujarat,* 1988 Supp SCC 241: 1988 SCC (Cri) 559: AIR 1988 SC 696; *Bonkya* v. *State of Maharashtra,* (1995) 6 SCC 447: 1995 SCC (Cri) 1113; *Bhag Singh,* (1997) 7 SCC 712: 1997 SCC (Cri) 1163; *Mohar* v. *State of Uttar Pradesh*, (2002) 7 SCC 606: 2003 SCC (Cri) 121 (SCC p. 606b-c); *Dinesh Kumar* v. *State of Rajasthan,* (2008) 8 SCC 270: (2008) 3 SCC (Cri) 472; *Vishnu* v. *State of Rajasthan,* (2009) 10 SCC 477: (2010) 1 SCC (Cri) 302; *Annareddy Sambasiva Reddy* v. *State of Andhra Pradesh,* (2009) 12 SCC 546: (2010) 1 SCC (Cri) 630 and *Balraje* v. *State of Maharashtra,* (2010) 6 SCC 673: (2010) 3 SCC (Cri) 211.] 29. While deciding this issue, a similar view was taken in *Jarnail Singh* v. *State of Punjab*, (2009) 9 SCC 719: (2010) 1 SCC (Cri) 107, where this Court reiterated the special evidentiary status accorded to the testimony of an injured accused and relying on its earlier judgments held as under: (SCC pp. 726-27, paras 28-29)

"Darshan Singh (PW 4) was an injured witness. He had been examined by the doctor. His testimony could not be brushed aside lightly. He had given full details of the incident as he was present at the time when the assailants reached the tubewell. In *Shivalingappa Kallayanappa* v. *State of Karnataka*, 1994 Supp (3) SCC 235: 1994 SCC (Cri) 1694 this Court has held that the deposition of the injured witness should be relied upon unless there are strong grounds for rejection of his evidence on the basis of major contradictions and discrepancies, for the reason that his presence on the scene stands established in case it is proved that he suffered the injury during the said incident.

29. In *State of Uttar Pradesh* v. *Kishan Chand,* (2004) 7 SCC 629: 2004 SCC (Cri) 2021 a similar view has been reiterated observing that the testimony of a stamped witness has its own relevance and efficacy. The fact that the witness sustained injuries at the time and place of occurrence, lends support to his testimony that he was present during the occurrence. In case the injured witness is subjected to lengthy cross-examination and nothing can be elicited to discard his testimony, it should be relied upon [vide *Krishan* v. *State of Haryana,* (2006) 12 SCC 459: (2007) 2 SCC (Cri) 214]. Thus, we are of the considered opinion that evidence of Darshan Singh (PW 4) has rightly been relied upon by the courts below."

30. The law on the point can be summarised to the effect that the testimony of the injured witness is accorded a special status in law. This is as a consequence of the fact that the injury to the witness is an inbuilt guarantee of his presence at the scene of the crime and because the witness will not want to let his actual assailant go unpunished merely to falsely implicate a third party for the commission of the offence. Thus, the deposition of the injured witness should be relied upon unless there are strong grounds for rejection of his evidence on the basis of major contradictions and discrepancies therein." In this very judgment, relationship between the medical evidence and ocular evidence was also discussed, based on number of earlier precedents, as under:

"33. In *State of Haryana* v. *Bhagirath,* (1999) 5 SCC 96: 1999 SCC (Cri) 658 it was held as follows: (SCC p. 101, para 15)

"15. The opinion given by a medical witness need not be the last word on the subject. Such an opinion shall be tested by the court. If the opinion is bereft of logic or objectivity, the court is not obliged to go by that opinion. After all opinion is what is formed in the mind of a person regarding a fact situation. If one doctor forms one opinion and another doctor forms a different opinion on the same facts it is open to the Judge to adopt the view which is more objective or probable. Similarly if the opinion given by one doctor is not consistent with probability the court has no liability to go by that opinion merely because it is said by the doctor. Of course, due weight must be given to opinions given by persons who are experts in the particular subject."

10.17 Clinching Corroboration[1]

It has been further observed that when there is ample unimpeachable ocular evidence and the same has received corroboration from the medical evidence, even the non-recovery of weapon does not affect the prosecution case. In the case at hand it is perceptible that PWs-1 and 2, brother and father of the deceased, have deposed in a vivid manner about the culpability of the accused persons in the crime. The autopsy surgeon, PW-3, has clearly opined that the deceased had died because of gunshot injuries.

The FSL report, Ext. P-AM/1, states with equal clarity that one cartridge was fired from left barrel of DBBL gun No. 56088, the other cartridge from its right barrel and three cartridges were fired from the rifle No. AB 97/5473. It is also brought out in the evidence the gun and the rifle were sent to the Forensic Science Laboratory in sealed parcels. As per the report the shots were fired from the weapons sent to the laboratory. It has been established by cogent evidence that the weapons belonged to the accused-appellants and licenses were issued in their favour. Thus, the ocular testimony of PWs-1 and 2 has received clear corroboration from the medical evidence as well as from the report of the FSL.

Needless to emphasise, on these counts the prosecution version cannot be held to be unbelievable and it cannot be held that the prosecution has not been able to establish the charges beyond reasonable doubt. It is because judicial

1. *Manjit Singh* v. *State of Punjab*, 2013 (4) MLJ (Crl) 200: (2013) 12 SCC 746.

evaluation of the evidence has to be appropriate regard being had to the totality of the facts and circumstances of the case and not on scrutiny in isolation and further the concept of proof beyond reasonable doubt cannot be made to appear totally unrealistic. In this context, we may profitably reproduce a passage from *Inder Singh* v. *The State (Delhi Administration)*[17]:—

> *"Credibility of testimony, oral and circumstantial, depends considerably on a judicial evaluation of the totality, not isolated scrutiny.*
>
> *While it is necessary that proof beyond reasonable doubt should be adduced in all criminal case, it is not necessary that it should be perfect. If a case is proved too perfectly, it is argued that it is artificial; if a case has some flaws, inevitable because human beings are prone to err, it is argued that it is too imperfect. One wonders whether in the meticulous hypersensitivity to eliminate a rare innocent from being punished, many guilty men must be callously allowed to escape. Proof beyond reasonable doubt is a guideline, not a fetish and guilty man cannot get away with it because truth suffers some infirmity when projected through human process. Judicial quest for perfect proof often accounts for police presentations of fool-proof concoction. Why fake up? Because the court asks for manufacture to make truth look true? No, we must be realistic."*

10.18 Daubert Ruling[1]

In USA Frye Ruling has provided guidelines to the courts for the acceptance of scientific evidence since its pronouncement in 1923[2]. The main burden of the ruling was that the expertise put before the court to assist it in the adjudication of a matter before the court should have **'General Acceptance'**. The principle of 'general acceptance' was used/abused in many a court case till it was overruled in 1993 in *Daubert's* case by the Supreme Court of USA. Daubert's ruling is also called **Daubert's Motion.**

The Supreme Court in this case pronounced the guidelines for accepting the expert evidence. The trier judge is asked to act as the gatekeeper to prevent the entry of junk science evidence and allow only real scientific evidence. He should see that:

1. The evidence being produced is relevant.
2. The 'general acceptance', as required in Frye's ruling, is not a necessary precondition.
3. The theory (principle) or technique involved in the expert evidence has reliable foundation.
4. The theory or the technique is amenable to testing.
5. The falsifiability or refutability should not exist.
6. The scientific application (theory or technique) should have undergone **'peer review'**. Publication (of the theory or technique) is one way of peer review. However, publication alone may not be sufficient.
7. The court should consider the known rate of error and take it into consideration while evaluating the expert evidence.

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1. *Daubert* v. *Merril Dow Pharmaceutical,* SCt 2783 (1993).
2. 293 F 1013 (DC Cr 1923).

The main idea behind the exercise, it seems, was to free the judiciary from the binding from the Frye's ruling and to save the jury from the mental tussle in handling the unknown principle or technique and often consequential confusion the noetic sciences create.

In India the Daubert's ruling, in spite a lot of discussions (much ado about nothing) by the legal luminaries, does not appear to be relevant. We have no jury trial system. Here the judge is all-powerful to accept or reject the *bona fide* of the expert and of a particular piece of evidence.

Case law enunciated by the Supreme Court over the decades provides excellent guideline to the subordinate courts on almost all facets of scientific evidence.

25

RELEVANT LAWS

THE ARMS ACT, 1959

(Relevant Provisions)

2. Definitions and interpretation.—

1(b) "ammunition" means ammunition for any firearm, and includes:

(i) rockets, bombs, grenades, shells [1][and other like missiles,]

(ii) articles designed for torpedo service and submarine mining,

(iii) other articles containing, or designed or adapted to contain, explosive, fulminating or fissionable material or noxious liquid, gas or other such thing, whether capable of use with firearms or not,

(iv) charges for firearms and accessories for such charges,

(v) fuses and friction tubes,

(vi) parts of, and machinery for manufacturing, ammunition, and

(vii) such ingredients of ammunition as the Central Government may, by notification in the Official Gazette, specify in this behalf.

1(e) "firearms" means arms of any description designed or adapted to discharge a projectile or projectiles of any kind by the action of any explosive or other forms of energy, and includes:

(i) artillery, hand-grenades, riot-pistols or weapons of any kind designed or adapted for the discharge of any noxious liquid, gas or other such thing,

(ii) accessories for any such firearm designed or adapted to diminish the noise or flash caused by the firing thereof,

(iii) parts of, and machinery for manufacturing, fire-arms, and

(iv) carriages, platforms and appliances for mounting, transporting and serving artillery.

1(h) "prohibited ammunition" means any ammunition containing, or designed or adapted to contain, any noxious liquid, gas or other such thing, and includes rockets, bombs, grenades, shells, [2][missile] articles designed for torpedo service and submarine mining and such other articles as the Central Government may, by notification in the Official Gazette, specify to be prohibited ammunition.

1(i) "prohibited arms" means:

(i) firearms so designed or adapted that, if pressure is applied to the trigger, missiles continue to be discharged until pressure is removed from the trigger or the magazine containing the missiles is empty, or

1. Subs. by Act 42 of 1988, section 2 w.e.f. 27-5-1988.
2. Ins. by Act 42 of 1988, section w.e.f. 27-5-1988.

(ii) weapons of any description designed or adapted for the discharge of any noxious liquid, gas or other such thing,

and includes artillery, anti-aircraft and anti-tank firearms and such other arms as the Central Government may, by notification in the Official Gazette, specify to be prohibited arms.

3. Licence for acquisition and possession of firearms and ammunition.—[1][(1)] No person shall acquire, have in his possession, or carry any firearm or ammunition unless he holds in this behalf a licence issued in accordance with the provisions of this Act and the rules made there under:

Provided that a person may, without himself holding a licence, carry any firearms or ammunition in the presence, or under the written authority, of the holder of the licence for repair or for renewal of the licence or for use by such holder.

[2][(2) Notwithstanding anything contained in sub-section (1), no person, other than a person referred to in sub-section (3), shall acquire, have in his possession or carry at any time, more than three firearms:

Provided that a person who has in his possession more firearms than three at the commencement of the Arms (Amendment) Act, 1983, may retain with him any three of such firearms and shall deposit, within ninety days from such commencement, the remaining firearms with the officer in charge of the nearest police station, or subject to the conditions prescribed for the purposes of sub-section (1) of section 21, with a licensed dealer or, where such person is a member of the armed forces of the Union, in a unit armory referred to in that sub-section.

(3) Nothing contained in sub-section (2) shall apply to any dealer in firearms or to any member of a rifle club or rifle association licensed or recognised by the Central Government using a point 22 bore rifle or an air rifle for target practice.

(4) The Provisions of sub-section (2) to (6) (both inclusive) of section 21 shall apply in relation any deposit of firearms under the proviso to sub-section (2) as they apply in relation to the deposit of any arms or ammunition under sub-section (1) of that section.]

5. Licence for manufacture, sale, etc., of arms and ammunition.—[3][(1)] No person shall,

(a) [4][use, manufacture,] sell, transfer, convert, repair, test or prove, or

(b) expose or offer for sale or transfer or have in his possession for sale, transfer, conversion, repair, test or proof,

any firearm or any other arms of such class or description as may be prescribed or any ammunition, unless he holds in this behalf a licence issued in accordance with the provisions of this behalf a licence issued in accordance with the provisions of this Act and the rules made thereunder:

[5][***]

[6][(2) Notwithstanding anything contained in sub-section (1), a person may, without holding a licence in this behalf, sell or transfer any arms or ammunition which he lawfully possesses for his own private use to another person who is entitled by virtue of this Act, or any other law for the time being in force to have, or is not prohibited by this Act or such other law from having in his possession such arms or ammunition:

1. Section 3 re-numbered as sub-section (1) thereof by Act 25 of 1983, section 3 w.e.f. 22-6-1983.
2. Ins. by section 3 of Act 25 of 1983, w.e.f. 22-6-1983.
3. Section 5 re-numbered as sub-section (1) thereof and in sub-section (1) as so renumbered the proviso omitted by Act 25 of 1983, section 4 w.e.f. 22-6-1983.
4. Subs. by Act 42 of 1988, section 3 w.e.f. 27-5-1988.
5. Section 5 re-numbered as sub-section (1) thereof and in sub-section (1) as so renumbered the proviso omitted by Act 25 of 1983, section 4 w.e.f. 22-6-1983.
6. Subs. by Act 25 of 1983, section 4 w.e.f. 22-6-1983.

Provided that no firearm or ammunition in respect of which a licence is required under section 3 and no arms in respect of which a licence is required under section 4 shall be sold or transferred by any person unless—

(a) he has informed in writing the district magistrate having jurisdiction or the officer in charge of the nearest police station, of his intention to sell or transfer such firearms, ammunition or other arms and the name and address of the person to whom he intends to sell or transfer such firearms, ammunition or the other arms, and

(b) a period of not less than forty-five days has expired after the giving of such information.]

6. Licence for the shortening of guns or conversion of imitation firearms into firearms.—No person shall shorten the barrel of a firearm or convert an imitation firearm into a firearm unless he holds in this behalf a licence issued in accordance with the provisions of this Act and the rules made thereunder.

Explanation.—In this section, the expression "imitation firearm" means anything which has the appearance of being a firearm, whether it is capable of discharging any shot, bullet or other missile or not.

7. Prohibition of acquisition or possession, or of manufacture or sale of prohibited arms or prohibited ammunition.—No person shall,

(a) acquire, have in his possession or carry; or

(b) [1][use, manufacture,] sell, transfer, convert, repair, test or prove; or

(c) expose or offer for sale or transfer or have in his possession for sale, transfer, conversion, repair, test or proof;

any prohibited arms or prohibited ammunition unless he has been specially authorised by the Central Government in this behalf.

8. Prohibition of sale of transfer of firearms not bearing identification marks.—(1) No person shall obliterate, remove, alter or forge any name, number or other identification mark stamped or otherwise shown on a firearm.

(2) No person shall sell or transfer any firearm which does not bear the name of the maker, manufacturer's number or other identification mark stamped or otherwise shown thereon in a manner approved by the Central Government.

(3) Whenever any person has in his possession any firearm, without such name, number or other identification mark or on which such name, number or other identification mark has been obliterated, removed, altered or forged, it shall be presumed unless the contrary is proved, that he has obliterated, removed, altered or forged that name, number or other identification mark:

Provided that in relation to a person who has in his possession at the commencement of this Act any firearm without such name, number or other identification mark stamped or otherwise shown thereon, the provisions of this sub-section shall not take effect until after the expiration of one year from such commencement.

9. Prohibition of acquisition or possession by, or of sale or transfer to, young persons and certain other persons of firearms, etc.—(1) Notwithstanding anything in the foregoing provisions of this Act,

(a) no person,

(i) who has not completed the age of [2][twenty-one years], or

(ii) who has been sentenced on conviction of any offence involving violence or moral turpitude to imprisonment for [3][any terms] at any time during a period of five years after the expiration of the sentences, or

1. Subs. by Act 42 of 1988, section 4 w.e.f. 27.5.1988.
2. Subs. by Act 25 of 1983, section 5 w.e.f. 22-6-1983.
3. Subs. by Act 25 of 1983, section 5 w.e.f. 22-6-1983.

(iii) who has been ordered to execute under Chapter VIII of the [1][Code of Criminal Procedure, (2 of 1974)] a bond for keeping the peace or for good behaviour, at any time during the term of the bond,

shall acquire, have in his possession or carry any firearm or ammunition;

(b) no person shall sell or transfer any firearm or ammunition to, or convert, repair, test or prove any firearm or ammunition for, any other person whom he knows, or has reason to believe—

(i) to be prohibited under clause (a) from acquiring, having in his possession or carrying any firearm or ammunition, or

(ii) to be of unsound mind at the time of such sale or transfer, or such conversion, repair, test or proof.

(2) Notwithstanding anything in sub-clause (i) of clause (a) of sub-section (1), a person who has attained the prescribed age-limit may use under prescribed conditions such firearms as may be prescribed in the course of his training in the use of such firearms:

Provided that different age-limits may be prescribed in relation to different types of firearms.

19. Power to demand production of licence, etc.—(1) Any police officer or any other officer specially empowered in this behalf by the Central Government may demand the production of his licence from any person whom is carrying any arms or ammunition.

(2) If the person upon whom a demand is made refuses or fails to produce the licence or to show that he is entitled by virtue of this Act or any other law for the time being in force to carry such arms or ammunition without a licence, the officer concerned may require him to give his name and address and if such officer considers it necessary, seize from that person the arms or ammunition which he is carrying.

(3) If that person refuses to give his name and address or if the officer concerned suspects that person of giving a false name or address or of intending to abscond, such officer may arrest him without warrant.

20. Arrest of persons conveying arms, etc., under suspicious circumstances.—Where any person is found carrying or conveying any arms or ammunition whether covered by a licence or not, in such manner or under such circumstances as to afford just grounds of suspicion that the same are or is being carried by him with intent to use them, or that the same may be used, for any unlawful purpose, any magistrate, any police officer or any other public servant or any person employed or working, upon a railway, aircraft, vessel, vehicle or any other means of conveyance, may arrest him without warrant and seize from him such arms or ammunition.

21. Deposit of arms, etc., on possession ceasing to be lawful.—(1) Any person having in his possession any arms or ammunition the possession whereof has, in consequence of the expiration of the duration of a licence or of the suspension or revocation of a licence or by the issue of a notification under section 4 or by any reason whatever, ceased to be lawful, shall without unnecessary delay deposit the same either with the officer in charge of the nearest police station or subject to such conditions as may be prescribed, with a licensed dealer or where such person is a member of the armed forces of the Union, in a unit armory.

Explanation.—In this sub-section "Unit armory" includes an armory in a ship or establishment of the Indian Navy.

(2) Where arms or ammunition have or has been deposited under sub-section (1), the depositor or in the case of his death, his legal representative, shall, at any time before the expiry of such period as may be prescribed, be entitled,

1. Subs. by Act 25 of 1983, section 5 w.e.f. 22-6-1983.

(a) to receive back anything so deposited on his becoming entitled by virtue of this Act or any other law for the time being in force to have the same in his possession, or

(b) to dispose, or authorise the disposal, of anything so deposited by sale or otherwise to any person entitled by virtue of this act or any other law for the time being in force to have, or not prohibited by this act or such other law from having, the same in his possession and to receive the proceeds of any such disposal:

Provided that nothing in this sub-section shall be deemed to authorise the return or disposal of anything of which confiscation has been directed under section 32.

(3) All things deposited and not received back or disposed of under sub-section (2) within the period therein referred to shall be forfeited to Government by order of the district magistrate:

Provided that in the case of suspension of a licence no such forfeiture shall be ordered in respect of a thing covered by the licence during the period of suspension.

(4) Before making an order under sub-section (3) the district magistrate shall, by notice in writing to be served upon the depositor or in the case of his death, upon his legal representative, in the prescribed manner, require him to show cause within thirty days from the service of the notice why the things specified in the notice should not be forfeited.

(5) After considering the cause, if any, shown by the depositor or, as the case may be, his legal representative, the district magistrate shall pass such order as he thinks fit.

(6) The Government may at any time return to the depositor or his legal representative things forfeited to it or the proceeds of disposal thereof wholly or in part.

22. Search and seizure by magistrate.—(1) Whenever any magistrate has reason to believe,

(a) that any person residing within the local limits of his jurisdiction has in his possession any arms or ammunition for any unlawful purpose, or

(b) that such person cannot be left in the possession of any arms or ammunition without danger to the public peace or safety, the magistrate may, after having recorded the reasons for his belief, cause a search to be made of the house or premises occupied by such person or in which the magistrate has reason to believe that such arms or ammunition are or is to be found and may have such arms or ammunition, if any, seized and detain the same in safe custody for such period as he thinks necessary, although that person may be entitled by virtue of this Act or any other law for the time being in force to have the same in his possession.

(2) Every search under this section shall be conducted by or in the presence of a magistrate or by or in the presence of some officer specially empowered in this behalf by the Central Government.

23. Search of vessels, vehicles arms, etc.—Any magistrate, any police officer or any other officer specially empowered in this behalf by the Central Government, may for the purpose of ascertaining whether any contravention of this Act or the rules made thereunder is being or is likely to be committed, stop and search and vessel, vehicle or other means of conveyance and seize any arms or ammunition that may be found therein along with such vessel, vehicle or other means of conveyance.

24. Seizure and detention under orders of the Central Government.—The Central Government may at any time order the seizure of any arms or ammunition in the possession of any person, notwithstanding that such person is entitled by virtue of this Act or any other law for the time being in force to have the same in his possession, and may detain the same for such period as it thinks necessary for the public peace and safety.

[1]**[24A. Prohibition as to possession of notified arms in disturbed areas, etc.—**(1) Where the Central Government is satisfied that there is extensive disturbance of public

1. Sections 24A and 24B inserted by Act 25 of 1983, section 7 w.e.f. 22-6-1983.

peace and tranquillity or imminent danger of such disturbance in any area and that for the prevention of offences involving the use of arms in such area, it is necessary or expedient so to do, it may by notification in the Official Gazette,

(a) specify the limits of such area;

(b) direct that before the commencement of the period specified in the notification (which period shall be a period commencing from a date not earlier than the fourth day after the date of publication of the notification in the Official Gazette), every person having in his possession in such area any arms of such description as may be specified in the notification (the arms so specified being hereafter in this section referred to as notified arms, shall, notwithstanding anything contained in any other provisions of this Act (except section 41) or in any other law for the time being in force, as from the date of publication such notification in the Official Gazette be deemed to have ceased to be lawful;

(c) declare that as from the commencement of, and until the expiry of, the period specified in the notification, it shall not be lawful for any person to have in his possession in such area any notified arms;

(d) authorise any such officer subordinate to the Central Government or a State Government as may be specified in the notification,

(i) to search at any time during the period specified in the notification any person in, or passing through, or any premises in, or any animal or vessel or vehicle or other conveyance of whatever nature in or passing through or any premises in or other container of whatever nature in, such area if such officer has reason to believe through, or any receptacle or other container of whatever nature in, such area if such officer has reason to believe that any notified arms are secreted by such person or in such premises or on such animal or in such vessel, vehicle or other conveyance or in such receptacle or other container,

(ii) the seize at any time during the period specified in the notification any notified arms in the possession of any person in such area or discovered through a search under sub-clause (i) and detain the same during the period specified in the notification.

(2) The period specified in a notification issued under sub-section (1) in respect of any area shall not, in the first instance exceed ninety days, but the Central Government may amend such notification to extend such period from time to time by any period not exceeding ninety days at any one time, in the opinion of that Government, there continues to be in such area such disturbance of public peace and tranquillity as is referred to in sub-section (1) or imminent danger thereof and that for the prevention of offences involving the use of arms in such area it is necessary or expedient so to do.

(3) The provisions of the Code of Criminal Procedure, 1973 (2 of 1974), relating to searches and seizures shall, so far as may be, apply to any search or seizure made under sub-section (1).

(4) For the purposes of this section,

(a) "arms" includes ammunition;

(b) where the period specified in a notification, as originally issued under sub-section (1), is extended under sub-section (2), then, in relation to such notification, references in subsection (1) to "the period specified in the notification" shall be construed as references to the period as so extended.

24B. Prohibition as to carrying of notified arms in or through public places in disturbed areas, etc.—(1) Where the Central Government is satisfied that there is extensive disturbance of public peace and tranquillity or imminent danger of such disturbance in any area and that for the prevention of offences involving the use of arms in such area it is necessary or expedient so to do, it may, by notification in the Official Gazette,

(a) specify the limits of such area;

(b) direct that during the period specified in the notification (which period shall be a period commencing from a date not earlier than the second day after the date of publication of the notification in the Official Gazette, no person shall carry or otherwise have in his possession any arms of such description as may be specified in the notification (the arms so specified being hereafter in this section referred to as notified arms) through or in any public place in such area;

(c) authorise any such officer subordinate to the Central Government or a State Government as may be specified in the notification,

(i) to search at any time during the period specified in the notification any person in or passing through, or any premises in or forming part of, or any animal or vessel or vehicle or other conveyance of whatever nature, in or passing through, or any receptacle or other container of whatever nature in, any public place in such area if such officer has reason to believe that any notified arms are secreted by such vessel, vehicle or other conveyance or in such receptacle or other container;

(ii) to seize at any time during the period specified in the notification any notified arms being carried by or otherwise in the possession of any person, through or in a public place in such area or discovered through a search under sub-clause (i) and detain the same during the period specified in the notification.

(2) The period specified in a notification issued under sub-section (1) in respect of any area shall not, in the first instance, exceed ninety days, but the Central Government may amend such notification to extend such period from time to time by any period not exceeding ninety days at any one time if, in the opinion of that Government, there continues to be in such area such disturbance of public peace and tranquillity as is referred to in sub-section (1) or imminent danger thereof and that for the prevention of offences involving the use of arms in such area it is necessary or expedient so to do.

(3) The provisions of the Code of Criminal Procedure, 1973, (2 of 1974), relating to searches and seizures shall, so far as may be, apply to any search or seizure made under sub-section (1).

(4) For the purposes of this section,

(a) "arms" includes ammunition;

(b) "public place" means any place intended for use by, or accessible to, the public or any section of the public; and

(c) where the period specified in a notification, as originally issued under sub-section (1), is extended under sub-section (2), then, in relation to such notification, references in sub-section (1) to "the period specified in the notification" shall be construed as references to the period as so extended.]

25. Punishment for certain offences.—[1][(1) Whoever,

(a) manufacturers, sells, transfers, converts, repairs, tests, or proves, or exposes or offers for sale or transfer, or has in his possession for sale, transfer, conversion, repair, test or proof, any arms or ammunition in contravention of section 5; or

(b) shortens the barrel of a firearms or converts an imitation firearm into a firearm in contravention of section 11,

(c) [2][***]

(d) brings into, or takes out of, India, any arms or ammunition of any class or description in contravention of section 11,

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1. Subs. by Act 25 of 1983, section 8 w.e.f. 22-6-1983.

2. Omitted by Act 42 of 1988, section 5 w.e.f. 27-5-1988.

shall be punishable with imprisonment for a term which shall not be less than three years but which may extend to seven years and shall also be liable to fine.

[1][(1A) Whoever acquires, has in his possession or carries any prohibited arms or prohibited ammunition in contravention of section 7 shall be punishable with imprisonment for a term which shall not be less than five years, but which may extend to ten years and shall also be liable to fine.

(1AA) Whoever manufactures, sells, transfers, converts, repairs, tests or proves or exposes or offers for sale or transfer or has in his possession for sale, transfer, conversion, repair, test or proof, any prohibited arms or prohibited ammunition in contravention of section 7 shall be punishable with imprisonment for a term which shall not be less than seven years but which may extend to imprisonment for file and shall also be liable to fine.]

[1][(1AAA)] Whoever has in contravention of a notification issued under section 24A in his possession or in contravention of a notification issued under section 24B carries or otherwise has in his possession, any arms or ammunition shall be punishable with imprisonment for a term which shall not be less than [2][three years, but which may extend to seven years] shall also be liable to fine.

(1B) Whoever,

(a) acquires, has in his possession or carries any firearm or ammunition in contravention of section 3; or

(b) acquires, has in his possession of carries in any place specified by notification under section 4 any arms of such class or description as has been specified in that notification in contravention of that section; or

(c) sells or transfers any firearm which does not bear the name of the maker, manufacturer's number or other identification mark stamped or otherwise shown thereon as required by sub-section (2) of section 8 or does any act in contravention of sub-section (1) of that section; or

(d) being a person to whom sub-clause (ii) or sub-clause (iii) of clause (a) of sub-section (iii) of clause (a) of sub-section (1) of section 9 applies, acquires, has in his possession or carries any firearm or ammunition in contravention of that section;

(e) sells or transfers, or converts, repairs, tests or proves any firearm or ammunition in contravention of clause (b) of sub-section (1) of section 9; or

(f) brings into, or take out of, India, any arm or ammunition in contravention of section 10; or

(g) transports any arms or ammunition in contravention of section 12; or

(h) fails to deposit arms or ammunition as required by sub-section (2) of section 3, or sub-section (1) of section 21;

(i) being a manufacturer of, or dealer in, arms or ammunition, fails, on being required to do so by rules made under section 44, to maintain a record or account or to make therein all such entries as are required by such rules or intentionally makes a false entry therein or prevents or obstructs the inspection of such record or account of the making of copies of entries there from or prevents or obstructs the entry into any premises or other place where arms or ammunition are or is manufactured or kept or intentionally fails to exhibit or conceals such arms or ammunition or refuses to point out where the same are or is manufactured or kept;

shall be punishable with imprisonment for a term which shall not be less than [3][one year] but which may extend to three years and shall also be liable to fine.

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1. Renumbered and inserted, by section 5, by Act 42 of 1988, w.e.f. 27-5-1988.
2. Subs. by Act 39 of 1985, section 2 for certain words.
3. Subs. by Act 39 of 1985, section 2 for "six months".

Provided that the Court may for any adequate and special reason to be recorded in the judgment impose a sentence of imprisonment for a term of less than [1][one year].

[2][(1C) Notwithstanding anything contained in sub-section (1B), whoever commits an offence punishable under that sub-section in any disturbed area shall be punishable with imprisonment for a term which shall not be less than three years but which may extend to seven years and shall also be liable to fine.

Explanation.—For the purposes of this sub-section, "disturbed area" means any area declared to be disturbed area under any enactment, for the time being in force, making provision for the suppression of disorder and restoration and maintenance of public order, and includes any area specified by notification under section 24A or section 24B.]

(2) Whoever being a person to whom sub-clause (i) of clause (a) of sub-section (1) of section 9 applies, acquires, has in his possession or carries any firearm or ammunition in contravention of that section shall be punishable with imprisonment for a term which may extend to one year, or with fine, or with both.

[2][(3) Whoever sells or transfers any firearm, ammunition or other arms,

(i) without informing the district magistrate having jurisdiction or the officer in charge of the nearest police station, of the intended sale or transfer of that firearm, ammunition or other arms; or

(ii) before the expiration of the period of forty five days from the date of giving such information to such district magistrate or the officer in charge of the police station,

in contravention of the provisions of clause (a) or clause (b) of the proviso to sub-section (2) of section 5, shall be punishable with imprisonment for a term which may extend to six months, or with fine of an amount which may extend to five hundred rupees, or with both].

(4) Whoever fails to deliver-up a licence when so required by the licensing authority under sub-section (1) of section 17 for the purpose of varying the conditions specified in the licence of fails to surrender a licence to the appropriate authority under sub-section (10) of that section on its suspension or revocation shall be punishable with imprisonment for a term which may extend to six months, or with fine of an amount which may extend to five hundred rupees, or with both.

(5) Whoever, when required under section 19 to give his name and address, refuses to give such name and address or gives a name or address which subsequently transpires to be false shall be punishable with imprisonment for a term which may extend to six months, or with fine of an amount which may extend to two hundred rupees, or with both.

[3]**26. Secret contraventions.**—(1) Whoever does any act in contravention of any of the provisions of section 3, 4, 10, or 12 in such manner as to indicate an intention that such act may not be known to any public servant or to any person employed or working upon a railway, aircraft, vessel, vehicle or any other means of conveyance, shall be punishable with imprisonment to seven years and also with fine.

(2) Whoever does any act in contravention of any of the provisions of section 5, 6, 7 or 11 in such manner as to indicate an intention that such act may not be known to any public servant or to any person employed or working upon a railway, aircraft, vessel, vehicle or any other means of conveyance, shall be punishable with imprisonment for a term which shall not be less than five years but which may extend to ten years and also with fine.

(3) Whoever on any search being made under section 22 conceals or attempts to conceal any arms or ammunition;

shall be punishable with imprisonment for a term which may extend to ten years, and with fine.]

1. Ins. by section 2, by Act 39 of 1985.
2. Subs. by Act 25 of 1983, section 8 w.e.f. 22-6-1983.
3. Subs. by Act 25 of 1983, section 9 w.e.f. 22-6-1983

[1][**27. Punishment for possessing arms, etc.**—(1) Whoever uses any arms or ammunition in contravention of section 5 shall be punishable with imprisonment for a term which shall not be less than three years but which may extend to seven years and shall also be liable to fine.

(2) Whoever uses any prohibited arms or prohibited ammunition in contravention of section 7 shall be punishable with imprisonment for a term which shall not be less than seven years but which may extend to imprisonment for life and shall also be liable to fine.

(3) Whoever uses any prohibited arms or prohibited ammunition or does any act in contravention of section 7 and such use or act results in the death of any other person, shall be punishable with death.]

28. Punishment for use and possession of firearms of firearms or imitation firearms in certain cases.—Whoever makes or attempts to make any use whatsoever of a firearm or an imitation firearm with intent to resist or prevent the lawful arrest or detention of himself or any other person shall be punishable with imprisonment for a term which may extend to seven years, [2][and with fine].

Explanation.—In this section the expression "limitation firearm" has the same meaning as in section 6.

29. Punishment for knowingly purchasing arms, etc., from unlicensed person or for delivering arms, etc., to person not entitled to possess the same.—Whoever,

(a) purchases any firearms or any other arms of such class or description as may be prescribed or any ammunition from any other person knowing that such other person is not licensed or authorised under section 5; or

(b) delivers any arms or ammunition into the possession of another person without previously ascertaining that such other person is entitled by virtue of this Act or any other law for the time being in force to have, and is not prohibited by this Act or such other law from having, in his possession the same,

shall be punishable with imprisonment for a term which may extend to six months, or with fine of an amount which may extend to [3][three years, or with fine, or with both].

30. Punishment for contravention of licence or rule.—Whoever contravenes any condition of a licence or any provision of this Act or any rule made thereunder, for which no punishment is provided elsewhere in this Act shall be punishable with imprisonment for a term which may extend to [4][six months] or with fine which may extend to [4][two thousand] rupees, or with both.

31. Punishment for subsequent offences.—Whoever having been convicted of an offence under this Act is again convicted of an offence under this Act shall be punishable with double the penalty provided for the latter offence.

32. Power to confiscate.—(1) When any person is convicted under this Act of any offence committed by him in respect of any arms or ammunition, it shall be in the discretion of the convicting court further to direct that the whole or any portion of such arms or ammunition, and any vessel, vehicle or other means of conveyance and any receptacle or thing containing, or used to conceal, the arms or ammunition shall be confiscated:

Provided that if the conviction is set aside on appeal or otherwise, the order of confiscation shall become void.

(2) An order of confiscation may also be made by the appellate court or by the High Court when exercising its powers of revision.

35. Criminal responsibility of persons in occupation of premises in certain cases.—Where any arms or ammunition in respect of which any offence under this Act has been or is being committed are or is found in any premises, vehicle or other place in the joint

1. Subs. by Act 42 of 1988, section 6 w.e.f. 27-5-1988.
2. Subs. by Act 25 of 1983, section 10 w.e.f. 22-6-1983.
3. Subs. by section 11, by Act 25 of 1983 w.e.f. 22-6-1983.
4. Subs. by Act 25 of 1983, section 12 w.e.f. 22-6-1983.

occupation or under the joint control of several persons, each of such persons in respect of whom there is reason to believe that he was aware of the existence of the arms or ammunition in the premises, vehicle or other place shall, unless the contrary is proved, be liable for that offence in the same manner as if it has been or is being committed by him alone.

38. Offences to be cognizable.—Every office under this Act shall be cognizable within the meaning of the [1][Code of Criminal Procedure, 1973 (2 of 1974)].

39. Previous sanction of the district magistrate necessary in certain cases.—No prosecution shall be instituted against any person in respect of any offence under section 3 without the previous sanction of the district magistrate.

45. Act not to apply in certain cases.—Nothing in this Act shall apply to,

(a) arms or ammunition on board any sea-going vessel or any aircraft and forming part of the ordinary armament or equipment of such vessel or aircraft;

(b) the acquisition, possession or carrying, the manufacture, repair, conversion, test or proof, the sale or transfer or the import, export or transport of arms or ammunition:—

(i) by or under orders of the Central Government, or

(ii) by a public servant in the course of his duty as such public servant, or

(iii) by a member of the National Cadet Corps raised and maintained under the National Cadet Corps Act, 1948 (31 of 1948) or by any officer or enrolled person of the Territorial Army raised and maintained under the Territorial Army Act, 1948 (56 of 1948), or by any member of any other forces raised and maintained or that may hereafter be raised and maintained under any Central Act, or by any member of such other forces as the Central Government may, by notification in the Official Gazette, specify, in the course of his duty as such member, officer or enrolled person.

(c) any weapon of an obsolete pattern or of antiquarian value or in disrepair which is not capable of being used as a firearm either with or without repair;

(d) the acquisition, possession or carrying by a person of minor parts of arms or ammunition which are not intended to be used along with complementary parts acquired or possessed by that or any other person.

THE ARMS RULES, 1962

(Relevant Provisions)

3. Classification of arms or ammunition.—For the purposes of the Act and these Rules, "arms" or "ammunition" shall be of the categories specified in columns 2 and 3 respectively of Schedule I and references to any category of arms or ammunition in these rules shall be construed accordingly.

Schedule I

CLASSIFICATION

Category	*Arms*	*Ammunition*
1	2	3
I	(a) Prohibited arms as defined in section 2(I)(i) and such other arms as the Central Government	Prohibited ammunition as defined in section 2(I)(h) and such other articles as the Central Government

1. Subs. by Act 25 of 1983, section 14 w.e.f. 22-6-1983.

1	2	3
	may, by notification in the Official Gazette, specify to be prohibited arms.	may, by notification in the Official Gazette, specify to be prohibited ammunition.
	(b) Semi-automatic firearms, smoothbore guns having barrel of less than 20″ in length.	Ammunition for arms of category I(b).
	(c) Rifles of .303 bore or of any other bore which can fire service ammunition of .303 bore; muskets of .410; pistols or revolvers of .441, .455 or any intermediate bores; or of .38 or .380 bore or of 9 mm caliber, or firing rimmed cartridges, having bore between .340″ and .365″.	Ammunition for firearms of category I(c).
	(d) Accessories for any firearms designed or adapted to diminish the noise or flash caused by the firing thereof.	Nil
II	Machinery for manufacture or prooftesting of a firearm.	Machinery for manufacturing ammunition.
III	Firearms other than those in categories I, II and IV, namely:	Ammunition for firearms other than those in categories I, II and IV, namely:—
	(a) Revolvers and pistols.	Ammunition for firearms of category III(a).
	(b) Breech-loading rifles other than .22 bore rifles mentioned in category III(c) below.	Ammunition for firearms of category III(b).
	(c) .22 bore (low velocity) rifles using rimfire cartridges, breech-loading smooth bore guns and air rifles.	Ammunition for firearms of category III(c).
	(d) Air guns and muzzle-loading guns.	Ammunition for firearms of category III(d).
IV	Curios and historical weapons other than those excluded under section 45(c).	Curios and historical ammunition.
V	Arms other than firearms: Sharp-edged and deadly weapons, namely—swords(includingsword-sticks), daggers, bayonets, spears (including lances and javelins); battle-axes, knives (including kirpans and khukries) and other	Nil.

1	2	3
	such weapons with blades longer than 9″ or wider than 2″ other than those designed for domestic, agricultural, scientific or industrial purposes, steel, batton: "Zipo" and other such weapons called "life preservers"; machinery for making arms, other than category II; and any other arms which the Central Government may notify under section 4.	
VI		VI (a) Articles containing explosives or fulminating materials, fuses and friction tubes. VI (b) Ingredients as defined in section 2(I)(b) (VII).

Note:—Parts and accessories of any arms or ammunition and charges for firearms and accessories for charges belong to the same category as the arms or ammunition.

10. Possession of arms or ammunition for certain purposes to include use thereof.— (1) Possession of the following arms or ammunition for the purposes mentioned against each includes use thereof, for such purposes only provided that such use does not involve manufacture of any arms or ammunition (including explosives and fireworks):—

(a) arms, for theatrical performance, cinematography production or signalling for starting races or athletic meets;

(b) ingredients of ammunition, for *bona fide* industrial, agricultural or medical purposes.

13. Of retainers.—(1) When the owner of any arms or ammunition licensed in Form III applies for permitting his agent, relative or employee to possess or carry any of the arms or ammunition covered by the licence for sport, protection or display, on his behalf, whether in attendance on him or not and in circumstances different from those mentioned in the proviso to section 3, such agent, relative or employee may, if the licensing authority considers it fit, be shown as a retainer by entering his name and other particulars in column 6 of the owner's licence in Form III.

Note.—The owner of any weapon may apply to the licensing authority to omit the name of the retainer and in all such cases, the licensing authority shall omit the name of the retainer. When a retainer ceases to be in the service of the owner, he shall not be entitled to possess or carry any of the arms or ammunition allowed until then, nor shall any person who subsequently comes in the service of the owner be so entitled until and unless his name and particulars are entered in like manner in the licence.

(2) A licence in Form III granted to a company for the protection of its premises or property shall be in the name of a member, agent or other representative of the company, who shall be responsible for the custody of the weapon. The name of a servant or any other employee entrusted with the weapon for guarding the premises or property of the company shall be entered as a retainer in the appropriate column of the licence. The licensing authority shall issue to the licensee a permit in Form III-B for each of such retainers shown in the licence. The permit shall remain in the personal custody of the representative of the company and shall be made over to the retainers when they are entrusted with the weapon covered by the licence.

(3) A licence in Form III-A for possession and carrying of arms or ammunition may be granted to a person nominated to be his retainer by a person exempted from licensing requirements:

Provided that the retainer shall have no right, independent of the person so exempted, to use the arms or ammunition covered by the licence, and the licence shall cease to be in force on the day on which the person so exempted has ceased to be an exemptee, or the retainer has ceased to be in the service of the exemptee.

14. Licences for protection of corps and cattle.—(1) Where a licence is granted in Form V, any member of the family of the licensee or a servant employed by the licensee to watch the crops or cattle and residing with him, may, at the discretion of the licensing authority, be allowed to carry any of the arms or ammunition covered by the licence to protect crops or cattle against wild animals in the area specified in the licence by entering his name and particulars in column 2 thereof.

(2) Where, after the end of any harvest season, the State Government considers it expedient that for the protection of wild life in any area, any arms or ammunition licensed in Form V should be deposited in a police station or with a licensed dealer, it may, by order, require any licensee to deposit such arms or ammunition for such period as the arms or ammunition are not required for the protection of crops or cattle and as may be specified therein, and thereupon the licensee shall be bound to comply with such order.

16. Age limit for training and target practice.—Any person below the age of sixteen years but not below the age of twelve years may be allowed to use a firearm for the purposes of training in the use of such firearm in the immediate presence, or under the direct supervision and guidance, of an adult instructor or the licensee:

Provided that no person below the age of sixteen years shall be allowed to carry any firearm requiring a licence, in a public place, except in the immediate presence and supervision of the person who is lawfully entitled to carry such firearm.

Explanation.—For the purpose of this rule, an 'adult' means a person who has completed the age of twenty-one years.

21. Conversion, repair, test, sale, etc.—(1) Where a licence is granted in form IX or Form XI for conversion or repair, but not manufacture, of any category of firearms or ammunition, it entitles the licensee to fabricate components or parts, for the purpose of conversion or repair of such firearms or ammunition but not to manufacture such components or parts to be utilised for assembling into complete firearms or ammunition of any category which he is not allowed to manufacture.

(2)(a) A licence in Form XI shall not entitle the dealer to shorten a firearm or to convert an imitation firearm into a firearm, unless he has a licence in Form IX showing specifically that he is permitted to shorten a firearm or convert an imitation firearm into a firearm.

(b) Under no circumstances shall a dealer shorten the barrel of a rifle or smooth bore gun so that the resultant length becomes less than 20 inches.

(c) The details of the cases in which barrels are shortened and imitation firearms are converted into firearms shall be reported every month to the district magistrate, in such form, if any, as may be required.

(3) A dealer having a licence in Form XI, Form XII or Form XIII to convert or repair or to sell firearms or ammunition shall not take the firearms or ammunition for testing to a testing range or other place, unless specifically permitted to do so by his licence and he shall carry out tests only in such manner and subject to such conditions as are laid down therein.

22. Proof testing of firearms.—(1) Proof testing of firearms manufactured by a licensed dealer shall be carried out only in accordance with the regulation which may be framed by the Central Government or framed by such authorities as the Central Government may specify in this behalf and approved by that Government.

(2) No dealer shall sell a firearm which has not been duly proof-tested.

25. Identification marks on firearms.—(1) a manufacturer of firearms shall get every firearm manufactured by him stamped so as to show distinctly—

(a) the maker's name and registered trade mark if any;

(b) the serial number of the weapon as entered in his register and the year of stamping; and

(c) proof-mark;

as shown in the following Table:—

TABLE

Weapon	*Manufacturer's name*	*Number*	*Proof mark*
1	2	3	4
1. D.B.B.L. weapons.	(i) On the rib at the top near the breech.	(i) On the fore-end.	(i) On the flats of action body.
		(ii) On the flats of barrel.	(ii) On the flats of barrel.
		(iii) On the flats of action body.	
2. S.B.B.L. weapons.	(i) On the barrel near the breech.	(i) On the fore-end.	(i) On the flats of action body
	(ii) On side plates.	(ii) On the flats of barrel.	(ii) On the flats of barrel.
		(iii) On the flats of action body.	
3. M.L. weapons.	(i) On the barrel or on the rib near the nozzle.	(i) On the barrel near the nozzle.	(i) On the barrel.
	(ii) On side plates.	(ii) On the action body.	
4. Revolvers	On the barrel.	(i) On the barrel.	(i) On the barrel.
		(ii) On chamber.	(ii) On body.
		(iii) On body.	
5. Pistols	On the frame.	On the frame.	On the barrel.

(2) When an imported firearm kept for sale by a dealer does not bear the manufacturer's name, such distinguishing mark of the importer as allotted by the state government shall be engraved on the barrel (adjacent to the number, if any, existing thereon) and on other parts as shown in column (2) of the Table under sub-rule (1); if a barrel bears more than one number, the distinguishing marks shall be affixed to the number appearing on the original invoice. When the manufacturer's number appears only on the trigger guard or other replaceable part, that number shall be engraved on the parts shown in column (3) of that Table.

(3) A person, who has in his possession any firearm which does not bear distinctly a manufacturer's name, number or other identification mark as mentioned in sub-rule (1), shall get the identification mark stamped on the firearm consisting of—

(a) such distinct letters as may be prescribed for the purpose by the state government;

(b) serial number of the possession licence in the Arms Register of the licensing authority concerned or, in respect of the firearm in possession of a person exempt from the obligation to take out licence for their possession, the letters 'Ex', and

(c) the year of stamping,

In that order and in the following manner:—

1.	Rifles	…	…	On the barrel and breech;
2.	Guns and pistols	…		On the barrel;
3.	Revolvers	…	…	On the breach and cylinder.

45. Licence to keep in custody arms and ammunition.—The licensee in Form XIV shall not accept for custody arms or ammunition without satisfying himself that there is no *mala fide* intention on the part of the depositor or any person on whose behalf the deposit is being made. The dealer shall either inform the nearest police station and the district magistrate personally, or despatch information to the officer-in-charge of the police station and the district magistrate by registered post on the day of deposit or return or disposal, as the case may be, of such arms or ammunition.

47. Deposit of arms and ammunition for sale custody (otherwise than under section 21).—(1)(a) A person lawfully possessing arms or ammunition may deposit them for safe custody with a dealer holding a licence in Form XIV or in a police station or, if he is a member of the armed forces of the Union, in a unit armoury.

(b) Before accepting the arms or ammunition for deposit otherwise than under section 21(1), the dealer or officer-in-charge of a police station or unit armoury shall satisfy himself that they are possessed under a valid licence issued under the Act and these rules or under exemption from the need for such licence.

(c) Members of the armed forces of the Union may be allowed to keep their arms or ammunition in safe custody in a unit armoury only during the tenure of their service.

(2) Where the arms or ammunition have been deposited under sub-rule (1), the dealer or the officer-in-charge of the police station or unit armoury shall—

(a) attach to each article deposited a card, easily distinguishable from that described in rule 46(2)(a) showing the following:—

Deposit for safe custody:—

(i) Description (No. etc.) of article .....

(ii) Name and address of depositor .....

(iii) Particulars of licence/exemption .....

(iv) Sl. No. in register and date of deposit .....

(v) Date of expiry of licence .....

(vi) Date up to which deposited .....

(vii) Signature of depositor .....

(viii) Signature of dealer or officer-in-charge of police station/unit armoury ....

(b) issue to the depositor a receipt containing the same particulars as in clause (a); and

(c) on the same day send a copy of the receipt to the authority who granted the licence or renewed it last.

(3)(a) In the event of failure to get the licence renewed, the arms or ammunition shall continue to be possessed by the dealer on the authority of his licence in Form XIV or by the officer-in-charge of the police station or unit armoury; but, if the licence is not renewed for a period of 3 years after its expiry, the dealer or the officer-in-charge of the police station or unit armoury shall bring this to the notice of the district magistrate for such action as he may consider necessary;

(b) the articles shall in no case be returned to the owner unless the licence to possess them is renewed or a new licence is obtained.

(4) The depositor may be charged a fee for the custody of the articles deposited at the following rates:

1.	For each firearm	One rupee per year or portion thereof.
2.	For every other weapon or package of ammunition.	50 np. per year or portion thereof.

Any extra charges for maintenance of the articles in good condition may be levied at such rates as may be fixed from time to time by the State Government.

63. Production of arms.—The authority by whom any licence in Form II, Form III, Form IV, Form V or Form VI has been granted or renewed, may, for the purpose of satisfying itself that any arms covered by such licence are still in the possession of the licensee, at any time while the licence is in force, by order in writing require the licensee—

(a) to produce the arms at such time and place for inspection of such officer as may be specified in the order; or

(b) at the option of the licensee, to produce a certificate from—

(i) a magistrate or the officer-in-charge of the nearest police station in whose jurisdiction the licensee resides or has his occupation, or

(ii) if he is a Government servant, a gazetted officer to whom he is subordinate,

to the effect that he has seen the arms in the possession of the licensee and that they correspond to the description given in the licence.

G.S.R. 988

In exercise of the powers conferred by sub-clause (vii) of clause (b) of sub-section (1) of section 2 of the Arms Act, 1959 (54 of 1959), the Central Government hereby specifies the following as ingredients of ammunition namely:—

(i) lead, sulphur, saltpeter, and sodium azide;

(ii) chlorates and perchlorates;

(iii) fissionable material; and

(iv) asphyxiating, poisonous, irritant or other gases and analogous liquid, materials or devices which are not used in any *bona fide* industrial process in India.

(No. 15/13/59(III)—P. IV.)

G.S.R. 989

In exercise of the powers conferred by clause (i) of sub-section (1) of section 2 of the Arms Act, 1959 (54 of 1959), the Central Government hereby specifies in the following arms as prohibited arms in addition to those mentioned in that clause, namely:—

Hand grenades, riot pistols, firearms for discharging projectiles by atomic energy, cannon, mortars and other ordnance and machine-guns, all carriages, accessories and appliances for mounting, transporting and serving the same.

(No. 15/13/59(III)—P. IV.)

G.S.R. 990

In exercise of the powers conferred by clause (h) of sub-section (1) of section 2 of the Arms Act, 1959 (54 of 1959), the Central Government hereby specifies the following articles as prohibited ammunition in addition to those mentioned in that clause namely:—

Ammunition for any of the prohibited arms, articles designed for land mining and ammunition containing or designed or adapted to contain any fissionable material or any noxious liquid, gas or other such thing.

(No. 15/13/59 (IV)—P. IV.)

Prohibited Arms & Ammunitions

Category		*Arms*	*Ammunition*
1		2	3
1	(a)	Prohibited arms as defined in section 2(I)(i) and such other arms as the Central Government may, by notification in the Official Gazette specify to be prohibited.	Prohibited ammunition as defined in section 2(1)(h) and such other article as the Central Government may, by notification in the Official Gazette, specify to be prohibited ammunition.
	(b)	Semi-automatic firearms other than those included in category I(c) and III(a), smooth-bore guns having barrel of less than 20″ in length.	Ammunition for arms of category 1(h).
	(c)	Bolt action or semi-automatic rifles of .303″ or 7.62 mm. bore or any other bore which can chamber and fire services ammunition of .303″ or 7.62 mm. calibre; musket of .410″ bore or any other bore which can fire .410″ musket ammunition; pistols, revolvers or carbines of any bore which can chamber and fire .380″ or .455″ rimmed cartridges or service 9 mm. or .45″ rimless cartridges.	Ammunition for firearms of category 1(c).
	(d)	Accessories of any firearms designed or adapted to diminish the noise or flash caused by the firing thereof.	

(M.H.A., O.M. No. 25/13/65-Ests. (A), dated 10-12-1969).

SCHEDULE II

ARMS AND AMMUNITION EXCLUDED (FROM LICENCE)

Arms and ammunition			*Provisions of the Act*	*Conditions*
1			2	3
1. (1)	(a)	Toy cannon weighing not more than 27 Kgs. and having—	All expect section 5.	
	(i)	calibre of less than one inch;		
	(ii)	length of bore of less than 24 inches; and		
	(iii)	interior of the bore unrifled.		
	(b)	Old iron cannon balls.		

1	2	3
(2) Recapper, decapper and turnover machines.	All; provided that the use of these machines is restricted to loading or re-loading cartridge for one's own personal use and for no other purpose.	
(3) Air guns, air rifles and air pistols which satisfy the following test, namely, that—the projectiles discharged from such guns or pistols do not perforate a target 12 inches square formed by deal-wood boards of even grain, free from knots, planed on both sides and of thickness of $^{1}/_{2}$" and 1" for air pistols and air guns/rifles respectively: Provided that in making and estimating the test the following conditions shall be observed, namely:— (a) the weapon shall be held horizontally with the muzzle at a distance of five feet from the target; (b) the test shall be repeated twenty times for each class of projectiles which can be discharged from the weapon; and (c) perforation shall be deemed to be effected— (i) in a case where the projectile is a dart, if the point of the dart pierces the back of the target, and (ii) in any other case, if the projectile passes completely through the back of the target.	All; provided that the Central Government may, by notification in the Official Gazette, retain all or any of the provisions of the Act in respect of air pistols or of any class thereof in the case of any class of persons or of any specified area.	
(4) Air guns, air rifles and air pistols required for imparting training in their use.	Those contained in sections 3 and 9(a)(i); provided that the exemption shall be valid only when the weapons are used in connection with training in their use and the training is imparted under the supervision of a licensee or an instructor approved by the Central Government in this behalf.	
(5) All arms	Those contained in section 5, in so far as it relates to	

1	2	3
	petty repairs without the use of spare parts, carried out by or in the presence of, or under the written authority of, the owner lawfully possessing the weapon, subject to such conditions and restrictions as may be imposed by the Central Government in this behalf.	
(6) Arms and ammunition required for, and not kept or used for any purpose other than, the navigation or operation of aircraft.	All.	
(7) Arms, other than filled or empty grenades, which are in the possession of a regiment or military mess as trophies or curiosities or otherwise solely for purposes of ornament or display.	All.	
(8) Sights for rifles imported for the use of; or for sale to, officers, junior commissioned officers, warrant officers and petty officers of the Indian Navy, Army or Air Force or of the Indian Territorial Army or non-commissioned officers and soldiers of the Indian Army on a written permit from the officer commanding the regiment to which they belong.	All.	
(9) (a) All explosive substances which may be used for filling the ammunition defined in section 2(1)(b)(iii), other than 'ingredients of ammunition, in item (vii) of that sub-clause, unless and until any of them becomes a part of such ammunition; fuses for blasting (safety or otherwise) tubes for firing explosives.	All expect those relating to export; provided that the Central Government may by notification in the Official Gazette retain all or any of the provisions of the Act, in the case of any class of persons or of any specific area.	
(b) Cartridges made with not more than 15 Kgs. of gun-powder, and not containing their own means of ignition, when intended *bona fide* for private blasting purposes.	Those contained in section 3; provided that the Central Government may by notification in the Official Gazette, at any time prohibit possession without a licence in the case of any class of persons	

1	2	3
	or any specified area, if it considers necessary to do so in the interest of public safety.	
(10) Gun wads and wire cartridges.	Those contained in section 10.	
(11) Cartridge cases of arms of 1 or more than 1 inch-bore.	All.	
(12) (a) Lead bullets and bird shot not exceeding 5 Kgs.	All; provided that the Central Government may impose in respect of any class of persons or of any specified area, any restriction in regard to the quantity of lead to be so exempted.	
(b) Pellets for air guns and lead required in good faith for industrial and manufacturing purposes (other than the manufacture of bullets and bird-shot) up to any quantity.		
(13) (a) Chlorates acquired, possessed or sold by *bona fide* medical practitioners and dispensing chemists in accordance with such conditions as may be prescribed by the Central Government.	Those contained in sections 3 and 5.	
(b) Medical preparations (including tablets) containing chlorates acquired, possessed or sold by medical practitioners or dispensing chemists or acquired or possessed by any one on the basis of a prescription or certificate by a medical practitioner, in accordance with such conditions as may be prescribed by the Central Government.	Those contained in sections 3 and 5.	
2. Arms of Category V	Those contained in sections 10 and 12, subject to the conditions that the arms are exported or transported by or through a dealer and in accordance with rule 61. Provided that the Central Government may, by notification in the Official Gazette, retain all or any of the provisions of the Act, relating to any area in respect of any type or description of arm.	The exemption shall apply to the whole of India except where section 4 applies.

	1	2	3
3. (1)	Kirpans possessed or carried by Sikhs.	Those contained in section 4.	The exemption shall apply to any part of India except where section 4 applies.
(2)	Khukries possessed or carried by Gurkhas of all classes.	Those contained in section 4. Provided that the Central Government may, by notification in the Official Gazette retain all or any of the provisions of the Act in this behalf in respect of all classes, or any class of Gurkhas, or of any specified area.	
(3)	Uniform swords and dirks of recognised military or official patterns, when possessed by, or intended to be supplied to, persons entitled to wear as uniforms.	Those contained in section 4.	
(4)	Swords of honour possessed or carried by persons or by the heirs of persons to whom they were awarded by the Central Government or by State Government.	Those contained in section 4.	
(5)	Swords imported for presentation as prizes for members of the regular or auxiliary force.	Those contained in sections 4 and 10.	
4. (1)	Sulphur in quantities not exceeding 50 Kgs.	All.	The exemption shall apply to the whole of India except all district on the external land frontier of India, and the districts of Sibsagar, Lakhimpur, and United Mikir and North Cachar Hills in Assam.
(2)	Saltpetre.	All.	
5.	Saltpetre required for medicinal or gold-smith's purposes in quantities not exceeding 5 Kgs.	All.	The exemption shall apply only to the districts on the external land frontier of India, and the districts of Sibsagar, Lakhimpur and North Cachar Hills in Assam.
6.	Any arms or ammunition brought into and landed in bond at, or brought into any port in India and declared under manifest to	Those contained in section 10.	

1		2	3
	be consignments for, any port to which export is not prohibited by rules or orders for the time being in force.		
7.	Arms and ammunition of category 1(c) imported by officers of the Indian Foreign Service.	Those contained in section 10.	
8.	Arms and ammunition of Category 1(c) imported by— (a) diplomatic personnel and home-based personnel of Foreign and Commonwealth Diplomatic Missions in India; and (b) Foreign (Career) Consular Officers, Consular Agents, Trade Commissioners, Assistant Trade Commissioners and Trade Agents in India.	Those contained in section 10.	Such arms and ammunition shall not be transferred to any one in India for consideration or otherwise.
9.	Arms and ammunition for despatch to the Government of Nepal or King of Nepal from or through India.	Those contained in section 10.	The arms etc., imported into, or acquired in India for transport or export to Nepal, shall correspond to the list furnished by the Central Government to the Customs authorities at the port of disembarkation or the licensing authority at other places.

(No.15/13/59(V)-P. IV)

THE PREVENTION OF TERRORISM ACT, 2002

(Relevant Provisions)

Preamble.—An Act to make provisions for the prevention of, and for dealing with, terrorist activities and for matters connected therewith.

4. Possession of certain unauthorised arms, etc.—Where any person is in unauthorized possession of any,—

(a) arms or ammunition specified in columns (2) and (3) of Category I or Category III(a) of Schedule 1 to the Arms Rules, 1962, in a notified area,

(b) bombs, dynamite or hazardous explosive substances or other lethal weapons capable of mass destruction or biological or chemical substances of warfare in any area, whether notified or not,

he shall be guilty of terrorist act notwithstanding anything contained in any other law for the time being in force, and be punishable with imprisonment for a term which may extend to imprisonment for life or with fine which may extend to rupees ten lakh or with both.

Explanation.—In this section "notified area" means such area as the State Government may, by notification in the Official Gazette, specify.

5. Enhanced penalties.—(1) If any person with intent to aid any terrorist contravenes any provision of, or any rule made under the Explosives Act, 1884 (4 of 1884), the Explosive Substances Act, 1908 (6 of 1908) or the Inflammable Substances Act, 1952 (20 of 1952), the Arms Act, 1959, he shall, notwithstanding anything contained in any of the aforesaid Acts or the rules made thereunder, be punishable with imprisonment for a term which may extend to imprisonment for life and shall also be liable to fine.

(2) For the purposes of this section, any person who attempts to contravene or abets, or does any act preparatory to the contravention of any provision of any law, rule or order, shall be deemed to have contravened that provision, and the provisions of sub-section (1) shall, in relation to such person, have effect subject to the modification that the reference to "imprisonment for life" shall be construed as a reference to "imprisonment for ten years".

THE EXPLOSIVE SUBSTANCES ACT, 1908

(Relevant Provisions)

[1]**2. Definitions.**—In this Act,

(a) the expression "explosive substance" shall be deemed to include any materials for making any explosive substance; also any apparatus, machine, implement

1. Subs. by the Explosive Substance (Amendment) Act, 2001. Prior to substitution sections 2 to 5 read as under:

"2. Definition of "explosive substance".—In this Act the expression "explosive substance" shall be deemed to include any materials for making any explosive substance; also any apparatus, machine, implement or material used, or intended to be used, or adapted for causing, or aiding in causing, any explosion in or with any explosive substances; also any part of any such apparatus, machine or implement.

3. Punishment for causing explosion likely to endanger life or property.—Any person who unlawfully and maliciously causes by any explosive substance an explosion of a nature likely to endanger life or to cause serious injury to property shall, whether any injury to person or property has been actually caused or not, be punished with transportation for life or any shorter term, to which fine may be added, or with imprisonment for a term which may extend to ten years, to which fine may be added.

4. Punishment for attempt to cause explosion, or for making or keeping explosive with intent to endanger life or property.—Any person who unlawfully and maliciously—

(a) does any act with intent to cause by an explosive substance, or conspires to cause by an explosive substance, an explosion in India of a nature likely to endanger life or to cause serious injury to property; or

(b) makes or has in his possession or under his control any explosive substance with intent by means thereof to endanger life, or cause serious injury to property in India, or to enable any other person by means thereof to endanger life cause serious injury to property in India,

shall, whether any explosion does or does not take place and whether any injury to person or property has been actually caused or not, be punished with transportation for a term which may extend to twenty years, to which fine may be added, or with imprisonment for a term which may extend to seven years, to which fine may be added.

5. Punishment for making or possessing explosives under suspicious circumstances.—Any person who makes or knowingly has in his possession or under his control any explosive substance, under such circumstances as to give rise to a reasonable suspicions that he is not making it or does not have it in his possession or under his control for a lawful object, shall, unless he can show that he made it or had it in his possession or under his control for a lawful object, be punishable with transportation for a term which may extend to fourteen years, to which fine may be added, or with imprisonment for a term which may extend to five years, to which fine may be added."

or material used, or intended to be used, or adapted for causing, or aiding in causing, any explosion in or with any explosive substance; also any part of any such apparatus, machine or implement;

(b) the expression "special category explosive substance" shall be deemed to include research development explosive (RDX), pentaerythritol tetra nitrate (PETN), high melting explosive (HMX), tri nitro toluene (TNT), low temperature plastic explosive (LTPE), composition exploding (CE) (2, 4, 6 phenyl methyl nitramine or tetryl), OCTOL (mixture of high melting explosive and tri nitro toluene), plastic explosive kirkee-1 (PEK-1) and RDX/TNT compounds and other similar type of explosives and a combination thereof and remote control devices causing explosion and any other substance and a combination thereof which the Central Government may, by notification in the Official Gazette, specify or the purposes of this Act.

3. Punishment for causing explosion likely to endanger life or property.—Any person who unlawfully and maliciously causes by,

(a) any explosive substance an explosion of a nature likely to endanger life or to cause serious injury to property shall, whether any injury to person or property has been actually caused or not, be punished with imprisonment for life, or with rigorous imprisonment of either description which shall not be less than (ten years, and shall also be liable to fine;

(b) any special category explosive substance an explosion of a nature likely to endanger life or to cause serious injury to property shall, whether any injury to person or property has been actually caused or not, be punished with death, or rigorous imprisonment for life, and shall also be liable to fine.

4. Punishment for attempt to cause explosion, or for making or keeping explosive with intent to endanger life or property.—Any person who unlawfully and maliciously,

(a) does any act with intent to cause by an explosive substance or special category explosive substance, or conspires lo cause by an explosive substance or special category explosive substance, an explosion of a nature likely to endanger life or to cause serious injury to property; or

(b) makes or has in his possession or under his control any explosive substance or special category explosive substance with intent by means thereof to endanger life, or cause serious injury to property, or to enable any other person by means thereof to endanger life or cause serious injury to property in India,

shall, whether any explosion does or does not take place and whether any injury to person or property has been actually caused or not, be punished,

(i) in the case of any explosive substance, with imprisonment for life, or with imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine;

(ii) in the case of any special category explosive substance, with rigorous imprisonment for life, or with rigorous imprisonment for a term which may extend to ten years, and shall also be liable to fine.

5. Punishment for making or possessing explosives under suspicious circumstances.—Any person who makes or knowingly has in his possession or under his control any explosive substance or special category explosive substance, under such circumstances as to give rise to a reasonable suspicion that he is not making it or does not have it in his possession or under his control for a lawful object, shall, unless he can show that he made it or had it in his possession or under his control for a lawful object, be punished,

(a) in the case of any explosive substance, with imprisonment for a term which may extend to ten years, and shall also be liable to fine;

(b) in the case of any special category explosive substance, with rigorous imprisonment for life, or with rigorous imprisonment for a term which may extend to ten years, and shall also be liable to fine.

6. Punishment of abettors.—Any person who by the supply of or solicitation for money, the providing of premises, the supply of materials, or in any manner whatsoever, procures, counsels, aids, abets or is accessory to, the commission of any offence under this Act shall be punished with the punishment provided for the offence.

7. Restriction on trial of offences.—No Court shall proceed to the trial of any person for an offence against this Act except with the consent of the [1][District Magistrate.]

THE EXPLOSIVE ACT, 1884

(Relevant Provisions)

4. Definitions.—In this Act, unless the context otherwise requires,—

* * * * * *

(d) "explosive" means gunpowder, nitroglycerine, nitroglycol, gun-cotton, dinitro-toluene, tri-nitro-toluene, picric acid, di-nitro-phenol, tri-nitro-resorcinol (styphnic acid), cyclo-trimethylene-tri-nitramine, penta-trythritol-tetranitrate, tetryl, nitro-guanidine, lead azide, lead styphynate, fulminate of mercury or any other metal, diazo-dinitrophenol, coloured fires or any other substance whether a single chemical compound or a mixture of substances, whether solid or liquid or gaseous used or manufactured with a view to produce a practical effect by explosion or pyrotechnic effect; and includes fogsignals, fireworks, fuses, rockets, percussion-caps, detonators, cartridges, ammunition of all descriptions and every adaptation or preparation of an explosive as defined in this clause;

* * * * * *

5. Power to make rules as to licensing of the manufacture, possession, use, sale, transport and importation of explosives.—(1) The Central Government may for any part of India makes rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale, transport, import and export of explosives, or any specified class of explosives.

* * * * * *

(3) Any person contravening the rules made under this section shall be punishable,—

(a) if he imports or manufactures any explosive in such contravention, with imprisonment for a term which may extend to three years, or with fine which may extend to five thousand rupees, or with both;

(b) if he possesses, uses, sells or transports any explosive in such contravention, with imprisonment for a term which may extend to two years, or with fine which may extend to three thousand rupees, or with both; and

(c) in any other case, with fine which may extend to one thousand rupees.

5A. Persons already in business in respect of certain explosives to carry on such business without licence for a certain period.—Notwithstanding anything in section 5 or in the rules made thereunder where, immediately before the commencement of the Indian Explosives (Amendment) Act, 1978, any person was carrying on the business of

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1. The words "Central Government" substituted by the Explosives Substances (Amendment) Act, 2001 w.e.f 11-12-2001.

manufacture, sale, transport, import or export of any explosive (for which no licence was required under this Act before its amendment by the Indian Explosives (Amendment) Act, 1978), then, such person shall be entitled to continue to carry on such business without licence in respect of such explosive—

(a) for a period of three months from the date of such commencement; or

(b) if before the expiry of the said period of three months, such person has made an application for grant of licence under this Act for such business in such explosive, until the final disposal of his application, whichever is later.

6. Power for Central Government to prohibit the manufacture, possession or importation of specially dangerous explosives.—(1) Notwithstanding anything in the rules under the last foregoing section, the Central Government may, from time to time, by notification in the Official Gazette,—

(a) prohibit, either absolutely or subject to conditions, the manufacture, possession or importation of any explosive which is of so dangerous a character that, in the opinion of the Central government, it is expedient for the public safety to issue the notification;

6A. Prohibition of manufacture, possession, sale or transport of explosives by young persons and certain other persons.—Notwithstanding anything in foregoing provisions of this Act,—

(a) no person,—

(i) who has not completed the age of eighteen years, or

(ii) who has been sentenced on conviction of any offence involving violence or moral turpitude for a term of not less than six months, at any time during a period of five years after the expiration of the sentence, or

(iii) who has been ordered to execute under Chapter VIII of the Code of Criminal Procedure, 1973, a bond for keeping the peace or for good behaviour, at any time during the term of the bond, or

(iv) whose licence under this Act has been cancelled, whether before or after the commencement of the Indian Explosives (Amendment) Act, 1978, for contravention of the provisions of this Act or of the rules made thereunder, at any time during a period of five years from the date of cancellation of such licence shall,—

(1) manufacture, sell, transport, import or export any explosive, or

(2) possess any such explosive as the Central Government may, having regard to the nature thereof, by notification in the Official Gazette, specify;

(b) no person shall sell, deliver or despatch any explosive to a person whom he knows or has reason to believe at the time of such sale, delivery or despatch,—

(i) to be prohibited under clause (a) to manufacture, sell, transport, import, export or possess such explosive, or

(ii) to be of unsound mind.

7. Power to make rules conferring powers of inspection, search, seizure detention and removal.—(1) The Central Government may make rules consistent with this Act authorizing any officer, either by name or in virtue of his office—

(a) to enter, inspect and examine any place, aircraft, carriage or vessel in which an explosive is being manufactured, possessed, used, sold, transported or imported under a licence granted under this Act, or in which he has reason to believe

that an explosive has been or is being manufactured, possessed, used, sold transported, imported or exported in contravention of this Act or of the rules made under this Act;

(b) to search for explosives therein;

(c) to take samples of any explosive found therein on payment of the value thereof; and

(d) to seize, detain and remove any explosive or ingredient thereof found therein and, if necessary, also destroy such explosive or ingredient.

(2) The provisions of the Code of Criminal Procedure, 1973 relating to searches under that Code shall, so far as the same are applicable, apply to searches by officers authorized by rules under this section.

8. Notice of accidents.—(1) Whenever there occurs in or about, or in connection with, any place in which an explosive is manufactured, possessed or used, or any aircraft, carriage or vessel either conveying an explosive or on or from which an explosive is being loaded or unloaded, any accident by explosion or by fire attended with loss of human life or serious injury to person or property, or of a description usually attended with such loss or injury, the occupier of the place, or the master of the aircraft or vessel or the person in charge of the carriage, as the case may be, shall within such time and in such manner as may be by rule prescribed give notice thereof and of the attendant loss of human life or personal injury, if any, to the Chief Controller of Explosives and to the officer in charge of the nearest police station.

9. Inquiry into accidents.—(1) Where any accident such as is referred to in section 8 occurs in or about or in connection with any place, aircraft, carriage or vessel under the control of any of Armed Forces of the Union, an inquiry into the causes of the accident shall be held by the naval, military, or air force authority concerned, and where any such accident occurs in any other circumstances, the District Magistrate shall, in cases attended by loss of human life, or may, in any other case, hold or direct a Magistrate subordinate to him to hold, such an inquiry.

(2) Any person holding an inquiry under this section shall have all the powers of a Magistrate in holding an inquiry into an offence under the Code of Criminal Procedure, 1973 and may exercise such of the powers conferred on any officer by rules under section 7 as he may think it necessary or expedient to exercise for the purposes of the inquiry.

(3) The person holding an inquiry under this section shall make a report to the Central Government stating the causes of the accident and its circumstances.

(4) The Central Government may make rules—

(a) to regulate the procedure at inquiries under this section;

(b) to enable the Chief Controller of Explosives to be present or represented at any such inquiry;

(c) to permit the Chief Inspector of Explosives in India or his representative to examine any witnesses at the inquiry;

(d) to provide that where the Chief Inspector of Explosives in India is not present or represented at any such inquiry, a report of the proceedings thereof shall be sent to him;

(e) to prescribe the manner in which and the time within which notices referred to in section 8 shall be given.

9A. Inquiry into more serious accidents.—(1) The Central Government may, where it is of opinion, whether or not it has received the report of an inquiry under section 9, that an inquiry of more formal character should be held into the causes of an accident such as

is referred to in sec. 8, appoint the Chief Controller of Explosives or any other competent person to hold such inquiry, and may also appoint one or more persons possessing legal or special knowledge to act as assessors in such inquiry.

(2) Where the Central Government orders an inquiry under this section, it may also direct that any inquiry under section 9 pending at the time shall be discontinued.

(3) The person appointed to hold an inquiry under this section shall have all the powers of a Civil Court under the Code of Civil Procedure, 1908, for the purposes of enforcing the attendance of witnesses and compelling the production of documents and material objects; and every person required by such person as aforesaid to furnish any information shall be deemed to be legally bound so to do within the meaning of section 176 of the Indian Penal Code.

(4) Any person holding an inquiry under this section may exercise such of the powers conferred on any officer by rules under section 7 as he may think it necessary or expedient to exercise for the purposes of the inquiry.

(5) The person holding an inquiry under this section shall make a report to the Central Government stating the causes of the accident and its circumstances and adding any observations which he or any of the assessors may think fit to make; and the Central Government shall cause every report so made to be published at such time and in such manner as it may think fit.

(6) The Central Government may make rules for regulating the procedure at inquiries under this section.

9B. Punishment for certain offences.—(1) Whoever, in contravention of rules made under section 5 or of the conditions of a licence granted under the said rules—

(a) manufacturers, imports or exports any explosive shall be punishable with imprisonment for a term which may extend to three years, or with fine which may extend to five thousand rupees, or with both;

(b) possesses, uses, sells or transports any explosive shall be punishable with imprisonment for a term which may extend to two years or with fine which may extend to three thousand rupees or with both; and

(c) in any other case, with fine which may extend to one thousand rupees.

(2) Whoever in contravention of a notification issued under section 6 manufactures, possesses or imports any explosive shall be punishable with imprisonment for a term which may extend to three years or with fine which may extend to five thousand rupees or with both, and in the case of importation by water, the owner and master of the vessel or in the case of importation by air, the owner and the master of the aircraft, in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with fine which may extend to five thousand rupees.

(3) Whoever,—

(a) manufactures, sells, transports, imports, exports or possesses any explosive in contravention of the provisions of clause (a) of section 6A; or

(b) sells, delivers or despatches any explosive in contravention of the provisions of clause (b) of that section,

shall be punishable with imprisonment for a term which may extend to three years or with fine or with both; or

(c) in contravention of the provisions of section 8 fails to give notice of any accident shall be punishable,—

(i) with fine which may extend to five hundred rupees, or

(ii) if the accident is attended by loss of human life, with imprisonment for a term which may extend to three months or with fine or with both.

10. Forfeiture of explosives.—When a person is convicted of an offence punishable under this Act or the rules made under this Act, the Court before which he is convicted may direct that the explosive, or ingredient of the explosive, or the substance (if any) in respect of which the offence has been committed, or any part of that explosive, ingredient or substance, shall, with the receptacle containing the same, be forfeited.

12. Abetment and attempts.—Whoever abets, within the meaning of the Indian Penal Code, the commission of an offence punishable under this Act, or the rules made under this Act, or attempts to commit any such offence and in such attempt does any act towards the commission of the same, shall be punished as if he had committed the offence.

13. Power to arrest without warrant persons committing dangerous offences.—Whoever is found committing any act for which he is punishable under this Act or the rules under this Act, and which tends to cause explosion or fire in or about any place where an explosive is manufactured or stored, or any railway or port, or any carriage, aircraft or vessel, may be apprehended without a warrant by a Police Officer, or by the occupier of, or the agent or servant of, or other person authorized by the occupier of, that place, or by any agent or servant of, or other person authorized by, the railway administration or conservator of the port or officer in charge of the airport, and be removed from the place where he is arrested and conveyed as soon as conveniently may be before a Magistrate.

15. Saving of (Arms Act, 1959).—Nothing in this Act shall affect the provisions of the Arms Act, 1959.

Provided that an authority granting a license under this Act for the manufacture, possession, sale, transport or importation of an explosive may, if empowered in this behalf by the rules under which the license is granted, direct by an order written on the license that it shall have the effect of a like license granted under the said Arms Act.

17. Extension of definition of "explosive" to other explosive substances.—The Central Government may, from time to time, by notification in the official Gazette declare that any substance which appears to the Central Government to be specially dangerous to life or property, by reason either of its explosive properties or of any process in the manufacture thereof being liable to explosion, shall be deemed to be an explosive within the meaning of this Act, and the provisions of this Act (subject to such exceptions, limitations and restrictions as may be specified in the notification) shall accordingly extend to that substance in like manner as if it were included in the definition of the term "explosive" in this Act.

THE INFLAMMABLE SUBSTANCES ACT, 1952

(Relevant Provisions)

2. Definitions.—In this Act,—

(a) "dangerously inflammable substance" means any liquid or other substance declared to be dangerously inflammable by this Act;

(b) "Petroleum Act" means the Petroleum Act, 1934 (30 of 1934).

3. Declaration of certain substances to be dangerously inflammable.—The liquids and other substances hereinafter mentioned, namely:—

(1) acetone,
(2) calcium phosphide,
(3) carbide of calcium,
(4) cinematograph films having a nitro-cellulose base,
(5) ethyl alcohol,
(6) methyl alcohol,
(7) wood naphtha,

are hereby declared to be dangerously inflammable.

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FORENSIC BALLISTICOPAEDIA

ACTION: Mechanism of a firearm, which, on manipulation, loads, extracts, ejects, reloads and re-fires the firearm. Only automatic action performs all these functions. Other actions perform one or more of these functions.

ACTION BLOCK: The metallic housing for the action.

AIR GUN, AIR PISTOL: The weapons in which compressed air, on release, propels the projectiles. The air is compressed with the help of a piston, a spring and manual action.

AMMUNITION: An assembly of propellant, projectile(s), and initiation mixture, contained in a container known as a 'shell' or a 'cartridge case'. The assembly is known as a cartridge, a round or a shot shell.

ANGLE OF DEPARTURE: Angle of elevation, firing angle.

ANGLE OF ELEVATION: The angle which the line of fire...barrel...makes with the horizontal.

ANGLE OF FALL: The angle which the tangent to the trajectory makes with the surface at which the bullet falls.

ANGLE OF IMPACT: The angle of fall, angle at which the projectile strikes the target.

ANTE-MORTEM INJURIES: Injuries suffered by the victim before death.

ANVIL: Metallic protrusion where the primer composition gets compressed and explodes when the hammer strikes the primer.

ARMOUR-PIERCING BULLET: A bullet with hard tungston core specially designed to pierce armoured vehicles.

ASSAULT RIFLE: Modified service rifle with lesser weight and shorter length usually. Famous assault rifles are AK 47, AK 74, used the world over.

AUTOMATIC: A firearm with automatic action. On pressing the trigger the firearm continues to fire till the magazine is empty or the trigger is released. Often misused term for self-loaders (Semi-automatic).

AUXILIARY BARREL: An additional firearm barrel which fits into the firearm stock and can replace the original barrel.

AXIS: Longitudnal central line of a bullet around which a rotating bullet revolves in its flight.

BACK SPATTER: See tail spatter.

BALL: A single lead missile used in smooth bore firearms.

BALL AMMUNITION: Ammunition with a fully jacked bullet.

BALLISTIC COEFFICIENT: It is a shape, weight, diameter and density dependent number assigned to a projectile which indicates its efficiency in the flight. It is given by:

$$C = \frac{m}{nd^2}$$

Here 'n' is the shape factor, 'm' is the mass and 'd' is the diameter of the projectile.

BALLISTICS: Science relating to the motion of the projectiles: Study of the behaviour of projectiles during its movement, in the barrel (interior ballistics), in the open (exterior ballistics) and at the target (terminal ballistics). Transitional Ballistics relates to movement of missile during its transition from interior to exterior Ballistics.

BALL POWDER: Ball-shaped propellant.

BARREL: A metallic (usually steel) tube of a firearm which provides the space for the burning of the propellant and development of pressure. The projectiles and other ejecta move out, on the firing of a cartridge, through barrel.

BASE WAD: A cardboard or a plastic piece inside the brass head of a shotgun cartridge.

BELT: A circular protrusion in the cylindrical part of a metallic cartridge case.

BELTED CARTRIDGE: A cartridge with a belt.

BERDAN PRIMER: A primer without an anvil in it. Details on p. 91.

BLACKENING: Black or greyish black smoke deposit around the entry hole on the target, in a close range fire.

BLACK POWDER: Gunpowder. Details in section 3.1.1.

BLANK CARTRIDGE: A cartridge without the projectile charge, intended to produce sound.

BLOW-BACK ACTION: The action in which the recoil operates the loading, locking and the firing mechanism of an automatic or a semi-automatic firearm.

BLUING: A process in which the firearm parts are boiled in a salt solution, giving the parts blue shade.

BOAT-TAILED: A bullet having a tapered base end. In the 7.62 Indian service rifle ammunition the tapering is 9^{o}.

BOLT: An important part of a bolt action firearm, housing the firing pin and related mechanism. On one end, there is a knob to hold it for moving it forward and backward. On the other end there is the bolt face through which the firing pin plunges and strikes the cartridge. The bolt face comes in close contact of the base of the cartridge.

BOLT ACTION : Details in section 2.5.6.2.

The bolt from its position is turned to bring the knob up. Backward pull cocks the weapon. Forward push take up a cartridge from the magazine.

BOLT HEAD, BOLT FACE: The breech face of a bolt.

BORE: The hole of a barrel tube of a firearm. Also the diameter (or calibre) of the barrel hole.

BOXER PRIMER: Primer fitted with an anvil in it. Details in section 3.3.

BREECH BLOCK: The steel block which closes the breech in certain firearms.

BREECH FACE: The area surrounding the firing pin against which the base of the loaded cartridge rests.

BREECH LOADER: A firearm which is loaded or unloaded at the breech.

BREAK FRAME REVOLVER: The revolver which opens at the chamber end, when a lever or a latch is operated, for loading or unloading.

BRISANCE: Shattering power of an explosive.

BUCKSHOT: They are comparatively heavy spherical shots, fired from a shotgun, to hunt bigger game; diameter 0.2" to 0.36".

BULK POWDER: The smokeless powder in which some inactive ingredients are mixed to increase the bulk.

BULLET: (1) The cylinderical projectile usually made of lead, often jacketed; usually fired from rifled firearm. (2) Any small calibre rifled firearm missile; details in section 3.2.

BULLET DROP: Vertical fall of a bullet during its flight due to gravitational pull.

BULLET WIPE: See DIRT RING.

BUTT: (1) The stock at the rear end of a firearm. In shoulder firearms it rests against the shoulder. (2) The site at which the firing is carried out (range).

BUTTON RIFLING: A method of rifling in which the hot carbide buttons engrave (print) the grooves in the barrels.

CALIBRE (Also caliber): It is the nominal diameter of a projectile or of a firearm. In the rifled barrels it is measured across the lands.

CANNELURE: A circular groove or fluting on the circumference of a bullet for better bullet case grip; or for placing grease.

CAP: Percussion cup.

CAP COMPOSITION: A mixture containing pressure sensitive explosive, like mercury fulminate, along with other components.

CARBINE: A rifle with shortened barrel, formerly used by cavalry.

CARTRIDGE: A complete round consisting of the projectile charge, the powder charge, percussion cap, etc., housed in a case (shell).

CARTRIDGE CASE: Housing for the primer, the projectiles, powder, etc. of a round; also called a shell.

CASELESS CARTRIDGE (Consumable cartridge): In cartridge, excluding bullet, every part of the round is consumed in the firing process.

CATTLE GUN: It is a specially designed firearm to kill domestic animals. It fires a blank 9 mm. (or other convenient calibre) cartridge. Not common in India.

CENTRE-FIRE CARTRIDGE: A cartridge with the primer mixture in the centre of its base.

CHAMBER: The housing cavity for a cartridge in a firearm, often in the barrel.

CHARGER: A clip carrying cartridges. It fits in the magazine of the firearm for which it is meant.

CHARRING (= Scorching = Burning = Singeing): Actual severe action of heat, damaging body tissues.

CHILLED PELLETS: The pellets cooled suddenly when the molten lead is allowed to fall from a height by blowing a blast of cold air in counter-current direction.

CHOKE: The constriction (narrowing) of the bore near the muzzle end of a shotgun.

CHRONOGRAPH: An instrument for measuring short intervals of time accurately, used in measuring the velocities of the projectiles.

CLASS CHARACTERISTICS: The marks, their general shapes and positions, left on the fired ammunition by he firearms of the same make and model.

CLIP: A metal device to hold several cartridges for loading into a rifle magazine or magazine of other firearm meant for the same.

COCK: A lever or the spring hammer, part of the mechanism for discharging a cartridge, so called from its original shape. It is also the process to manipulate the cock for firing.

COMPARISON CAMERA: A camera with two identical objective lenses of short focal length but with one screen. Two small objects (like bullets) can be seen and photographed side by side at the same time with this camera.

COMPARISON MICROSCOPE: An instrument for comparing two objects or two sets of marks. A combination of the optics of two microscopes where the images of the two objects, formed by the two microscopes, are brought in focus in the same eyepiece or on the screen, where they are seen side by side.

COMPENSATOR: A device attached to muzzle to reduce the recoil.

COMPOSITE PHOTOGRAPH: A compound photograph formed from two photographs or two images in such a way that part of one photo or one image is in continuation of the other.

CONE (= leed): The tapering barrel part which joins the chamber and the bore.

CONOIDAL BULLET: (= Cylindro-conoidal bullet = Spitzer Bullet). The bullet has a cylindrical body with a pointed nose.

CONSUMABLE CARTRIDGE: (= caseless cartridge) A cartridge in which, excluding the bullet, the whole of the cartridge is made of consumable material, which is consumed in the firing process.

CONVERSION BARREL: An additional barrel which can be fitted into the standard barrel of a weapon and thus different calibre ammunition can be fired from the same.

CORDITE: The name of a class of smokeless powder. It is a double base propellant and contains nitroglycerine and nitrocellulose.

CORE: The inner central part (made of lead or of other materials) of a jacketted bullet.

CORROSION: The eating up of a barrel (bore) or other part of the firearm by rusting or by the action of the corrosive materials.

COUNTRY-MADE FIREARM: Misnomer for an improvised firearm.

CRACKER: Fire cracker.

CRIMPING: The closing of a shotgun cartridge by turning in the edge, to keep the overshot wad (or the projectiles) in position and pressed.

CUPRO-NICKEL: An alloy used for the bullet jackets, consisting of copper and nickel.

CUTTS COMPENSATOR: A device fitted to the muzzle of a shotgun to reduce recoil and to take choke tube.

CYLINDER: Revolving wheel of a revolver. It chambers the live and the fired cartridges.

CYLINDRICAL BARREL: The shotgun barrel in which the diameter of the bore is the same throughout.

CYLINDRO-CONOIDAL BULLET: A bullet with conical pointed nose and cylindrical body. Also called spitzer bullet.

DAMASCUS BARREL: Barrel made from strips of iron or steel wound round in a spiral and welded together to form a tube. They are no longer in use.

DEFLAGRATION: Burning of materials (usually propellants) rapidly.

DEGRESSIVE POWDER: The propellant in which the surface area decreases continuously as burning proceeds.

DENSE POWDERS: The propellants which do not contain inactive matter to increase the bulk—the term is opposite to the bulk powder.

DERMAL NITRATE TEST: A chemical test, to identify GSR. Details in section 9.5.4.

DETONATION: Extremely rapid explosion. Reaction speed about three to nine thousand metres per second.

DIRT RING: A black collar on the edges of a gunshot wound due to the deposit of the dirt or the graphite, being present on the projectiles at the time of entering the target. Also called wipe ring.

DISCHARGE RESIDUE: The residues created in the firing process of a cartridge. Residues come from the combustion of the propellants, primer composition and from the barrels. Common name is GSR.

DOUBLE ACTION REVOLVER: A revolver is a double action revolver if the two actions, of revolving the wheel, to bring a live cartridge to the firing position, and then releasing the firing mechanism, to hit the cartridge for firing, are carried out by just one operation, *i.e.*, by pressing the trigger once.

DOUBLE BASE POWDER: The smokeless propellant containing nitroglycerine and nitrocellulose is called double base powder or propellant.

DRIFT: Sideway shift of the bullets due to the effect of the wind or of the spin of the bullets. Details: section 5.7.13.

DROP: The vertical distance between the actual position of projectile and its calculated position if there were no force of gravity acting upon it to bring it downwards.

DROPPED SHOT: Chilled pellets.

DUM-DUM BULLET: The bullet with a soft nose. It expands (breaks up) on hitting the target. They were manufactured at Dum Dum, Calcutta to start with.

EJECTOR: The mechanism or the device which helps to push out the fired cartridges from the firearm.

ELECTROPLATED BULLETS: Lead bullets covered with copper, deposited by electrolytical process.

ELEVATION: The angle of fire.

ENERGY: The capacity to do work. In firearms the kinetic energy of the projectile determines its destructive potential. It is given by:

$$\mathbf{E = 1/2\ mv^2\ [=1/2WV^2/g]}$$

(m = mass and v = velocity of the projectile, W is its weight and 'g' is gravity.)

EROSION: Slow wearing away of the barrel bore by hot gases and projectiles, resulting in widening of the bore of the barrel.

ESCAPE VELOCITY: The velocity at which a body, when hurled into the air, escapes from the gravitational pull of the earth and escapes into space.

EVIDENTIARY CLUES: Entities, including marks, stains and smell, etc. which connect the culprit with the crime, the victim, the scene or the instrument of crime.

EXCHANGE PRINCIPLE: When two objects come in contact, visible or invisible traces are always exchanged by them.

EXPANDING BULLET: A bullet which fragment (or expand) on hitting a target.

EXPANSIVE BALL: A smooth bore projectile made of lead which fragments on striking.

EXTERIOR BALLISTICS: See BALLISTICS and section 5.7.

EXTRACTOR: A part of the firearm mechanism which pulls out a cartridge or a case from the chamber.

FATAL INJURY: The injury which can cause death in the ordinary course.

FILAR MICROMETER EYEPIECE: An eyepiece of (or for) a microscope which permits measuring lengths and breadths of microscopic (small) dimensions.

FIREARM: A common name for all weapons which propel projectiles through expanding gases, produced by propellants or otherwise.

FIRE CRACKER: Small explosive devices (usually toy) containing low power explosives, which explodes with a sharp report.

FIRING PIN: The part of the mechanism which strikes the primer of a cartridge or other explosive device and initiates the firing.

FIXED AMMUNITION: The complete round or cartridge.

FLASH SUPPRESSOR: An attachment to the muzzle - a tube with slits around, which permit multidirectional escape of gases and hence a prominent flash does not occur. The device is commonly used in service rifles.

FLATS: The flat part of the action block on which the barrel rests in smooth bore firearms. Also the corresponding flat parts of the barrels.

FLECHETTES: The arrow-like projectiles, usually made of steel. They are being used in some smooth bore ammunition.

FLINT: A piece of stone (pure silica) which on striking against steel gives sparks.

FLINT LOCK: (1) The firearm which uses the flint to ignite powder. (2) The mechanism of the flint lock firearm.

FORE-END: The forepart of the stock of a firearm, the wooden piece underneath the barrel.

FOULING: The metallic and powder residues deposited in the barrel.

FRAGILE BULLET: Made from iron or other metal dust. They fragment on hitting the target.

FULL CHOKE: A barrel with a constriction of about 1 mm. at the muzzle.

GALLERY BULLETS: They are fragile bullet, made for .22 rifles.

GAS-CHECK BULLET: A lead bullet having a hard metal (Copper) cup covering its base, to prevent the hot gases coming in direct contact with the lead bullet.

GAS CUTTING: The formation of minute canals in the firearm cone, due to the continued and increasing escape of hot gases.

GAS-OPERATED ACTION: The automatic or the semi-automatic action of a firearm actuated by a small amount of the gases diverted for the purpose.

GAS PORT: A hole in the barrel through which the gases are diverted to actuate the mechanism of an automatic or a semi-automatic firearm.

GAS VENT: The hole(s) in some semi-automatic rifle/shotgun barrels to release gases after their function is over. They reduce recoil.

GAUGE: US term for the bore or bore diameter of a shotgun.

GILDING METAL: An alloy of copper (~ 90%) and zinc (~10%) used in the manufacture of the jackets of the bullets and percussion caps.

GRAIN: Weight measure; it is equal to 1/7000 pound.

GRIP: The part of a firearm from where the firearm is held.

GROOVES: The canals like furrows, usually in spiral shape, engraved in the bore of a rifled firearm.

GUN: General name of a firearm.

GUN COTTON: (= Nitro-cellulose), The basic constituent of all smokeless propellants.

GUN POWDER: (= black powder), The first important propellant used. It is a mixture of potassium nitrate, charcoal and sulphur (75:15:10).

GUNSHOT RESIDUES (GSR): Propellant and primer residues left after firing. Details in Chapter 9.

GYRATORY MOTION: The spinning motion of a projectile (or other object). In this motion the bullet or the object revolves around its own axis.

HALF CHOKE: A barrel with a constriction of about half a millimetre at the muzzle end.

HALF COCK: Some firearms can be cocked in two stages. The first stage of the cocking is known as half cock. In this position it cannot be fired by pressing the trigger.

HEMORRHAGE: Bleeding due to the rupture of blood vessels.

HAMMER: The component which hits or pushes the firing pin to strike the cartridge for firing.

HAMMERLESS GUN: (1) A name given to a gun in which there is no visible hammer.

(2) In some firearms there is no hammer, visible or concealed. Instead the firing pin is actuated by a spring. These firearms alone are truly hammerless.

HANDGUN: A short barrelled firearm (like pistol and revolver), fired with one hand.

HANGFIRE: The abnormal delay in firing of a cartridge after the firing pin has struck the primer.

HARRISON AND GILROY'S TEST: A chemical spot test to establish the presence or absence of Lead, Antimony and Barium in discharge residues. Details in section 9.5.6.

HEAD SPACE: The distance between the base of the cartridge and the breech face in a loaded gun.

HIGH INTENSITY CARTRIDGES: The cartridge which can propel projectiles at velocities over 800 metres per second.

HIGH POWER CARTRIDGES: The cartridges capable of propelling projectiles at velocities of 600 - 800 metres per second.

HINGED FRAME: See top break action.

HOLLOW POINT: An expanding bullet having empty space in its nose.

HUMANE GUN: Cattle gun.

IMPROVISED FIREARM: It is a non-standard gun, not made by a standard firm, to any standard specifications. Instead, it is assembled from the available or improvised material, for the available ammunition.

INCENDIARY BULLET: It is a bullet capable to set the target on fire, on impact.

INDIVIDUAL CHARACTERISTICS: Such features in the marks which individualise the source of the marks.

INDIVIDUALITY: The uniqueness of an entity.

INDIVIDUALITY, LAW OF: The law of individuality states that everything in this universe is individualistic. Neither the nature has repeated itself nor the man can. In other words, no two items, whether man-made or natural, are exactly alike.

INTERIOR BALLISTICS: See ballistics.

IRON PYRITE: Iron sulphide used in producing sparks in wheel lock firearms.

JACKET: The hard metal or alloy case, covering the lead core of a bullet.

JOUNEE'S FORMULA: It determines the range of shotgun fire from pellets dispension:

Pellet dispersion circle diameter in inches x 2200 = Range in yards

JUG CHOKE: A cavity near the muzzle having the bore diameter greater than the diameter anywhere else in the barrel.

JUMP: The displacement of the muzzle of a firearm, on firing, in the vertical or in the horizontal plane.

JUXTAPOSITION MATCH: The comparison of marks by bringing the marks on test and crime exhibits in corresponding side by side positions.

KEY HOLE: An elongated key-like hole or wound, caused by a bullet when it enters the target length-wise.

KHUKHRI: A sword-like weapon (but smaller) used by Gurkhas of India and Nepal.

KICK: It is the rear-ward push or jerk a firer suffers due to recoil, on the firing of a weapon.

KILLING POWER: The minimum energy which ensures killing.

KNURLED KNOB: A knob with a corrugated surface which permits a better grip.

LAND: The uncut raised portion (in spiral shape) between the two grooves of the barrel of a rifled firearm.

LEAD AZIDE: (= PbN_3). A highly sensitive explosive, used in place of mercury fulminate as the initiation agent.

LEADING: The lead deposit as fouling, in the barrel.

LEED: See Cone.

LETTER INSCRIPTIONS: The letters found engraved on the base of a cartridge. They are: **R**, it stands for 'rimmed'; **B**; for 'belted', **SR,** for 'semi-rimmed'.

LEVER ACTION: An action of a firearm operated by a lever. It is usually on the underside of the firearm and acts as trigger guard also.

LINE OF SIGHT: The line joining the sights and the target.

LOAD: To charge a firearm for firing or the charge of a cartridge.

LOADING DENSITY: It is the ratio between the space occupied by powder to the total space available in a cartridge case.

LUGS: The projected pieces of steel underneath the barrel of a breech loading shotgun, which fits in the corresponding slots on the action block, to hold the barrel and the action block firmly.

MACHINE GUN: An automatic firearm firing small arms ammunition at a rapid rate, part of service weapon system.

MACROPHOTOGRAPHY: Taking magnified photographs with short focal length lens, without the use of a microscope.

MAGAZINE: The part of a repeating firearm which holds a number of cartridges.

MAGNUM CARTRIDGE: A cartridge having extra propellant and projectile charge which makes it more powerful than the normal cartridge.

MARKS: The common name given to the two dimensional prints and the three dimensional impressions, caused by the static or the sliding contact of two surfaces.

MATCH LOCK: A firearm or its mechanism in which the initiation of firing is done through a smouldering wick. No more in use.

MAXIMUM RANGE: The longest distance to which a projectile can travel.

MERCURY FULMINATE Hg $(ONC)_2$: A highly pressure sensitive explosive which on being hit, gives flame and heat rays.

METAL-CASED BULLET: The jacketted bullet.

METALLIC FOULING: The metallic residues from bullets, left in the barrel on firing.

MICROSCOPY: The technique by which the minute evidence is magnified with a microscope and observed. Also see comparison microscope.

MID RANGE: The mid point of the total range.

MISFIRE: The failure of a cartridge to discharge, on being properly hit.

MULTI-AMMUNITION FIREARM: The firearm which can fire ammunition of different calibres.

MULTI-BARRELLED FIREARMS: The firearms which have more than two barrels.

MUSHROOMING: The formation of an umbrella (or mushroom) like structure by a bullet after hitting the target.

MUSKET: A shoulder firearm with smooth bore barrel. For example, .410 musket used in India and in some other parts of the world.

MUZZLE: The foremost end of a barrel.

MUZZLE BLAST: Sudden exit (and expansion) of gases from the muzzle. It takes place after the exit of the projectile(s). Expansion many take inside the target.

MUZZLE BRAKE: A device, usually a tube, with slits all around, for the escape of gases, which fits on the muzzle of a firearm. It reduces the recoil.

MUZZLE ENERGY (of a projectile)**:** It is the kinetic energy of the projectile, at the muzzle, given by:

$$\textbf{Muzzle Energy = K.E. = 1/2 M } V^2$$

MUZZLE FLASH: The light seen at the muzzle with the muzzle blast.

MUZZLE-LOADER: A firearm which is loaded through the muzzle.

MUZZLE PATTERN/MARKS: The marks of the muzzle of a firearm left at the target when the firearm is fired with muzzle pressed to the target.

MUZZLE VELOCITY: The velocity of a projectile at the muzzle.

NEUTRON ACTIVATION ANALYSIS: An analytical technique using neutrons, to create artificial radioactivity in elements, which identifies various metallic elements of the sample, present even in micro or sub-micrograms.

NIPPLE: A small steel tube screwed on to a muzzle-loader on which the percussion cap is placed for firing.

NITROCELLULOSE: See gun cotton.

NITROGLYCERINE: An explosive material used in the manufacture of the propellants and for blasting explosives, like dynamite.

NON-PROHIBITED ARMS/AMMUNITION: They are such firearms and ammunition which are not prohibited by the government and can be possessed by the public, after obtaining licence. For example, shotguns, air rifles, etc.

NOSE: The tip of a bullet.

OBTURATION: It is the sealing of the breech end of a gun by the expanded cartridge case, on firing, to prevent the escape of gases from the breech end.

OGIVE: Taperred part of conical bullet.

OVER AND UNDER GUN: A double-barrelled firearm with barrels placed one over the other.

PAN: A dish shaped container cavity in which the gunpowder was placed and ignited, to initiate fire in match lock, wheel lock and flint lock firearms.

PANTASCOPIC CAMERA: Periphery camera.

PAPER-PATCH BULLET: The lead bullets covered with paper, to minimise deformation.

PARADOX BULLET: A conical lead projectile, fired from the paradox shotgun.

PARADOX GUN: The shotgun with a barrel having shallow grooves near the muzzle-end.

PELLET: A small sphere of any metal, usually of lead or a lead alloy used in smooth bore firearms.

PENETRATION: The depth to which an object has been pierced by a projectile.

PEPPERING (= tattooing = stippling): Embedding of the un-burned and semi-burnt powder particles at the target surface.

PERCUSSION CAP (= primer): The initiating device forming part of the fixed ammunition. See primer.

PERIPHERY CAMERA: A camera which photographs the whole circular surface of a bullet contiguously on to a straight sheet of film.

PHOTOMICROGRAPHY: The photography of the microscopic evidence observed through a microscope.

PISTOL: The general name for a handgun or a self-loader or an automatic handgun.

PISTOL GRIP: See grip.

PITCH: (Also called twist). It is the barrel length in which the rifling completes one turn (360°). In 7.62mm rifle one turn is completed in 12 inches.

PNEUMATIC FIREARMS: The air guns, air rifles, and air pistols which propel projectiles with the help of compressed air.

POINT BLANK RANGE: A close range from where proper aiming is not needed.

POLY CHOKE: The commercial name of a tube in which the degree of choke can be varied at will by just rotating a knob.

POST-MORTEM: Medical examination of the dead to determine the cause of death and to find out other information about the death from the examination of the dead body.

POST-MORTEM INJURIES: The injuries inflicted on a dead body.

POWDER: The common name for all propellants.

POWER PISTON: A trade name for a single plastic wad system which replaces all wads in a shotgun cartridge. It seals the barrel, protects projectiles from the damage due to the contact friction with the barrel and provides the cushioning effect to the charge in the initial stages.

PRIMER: A metallic cup containing initiating ingredients to set the propellant on fire on being hit. There are two types: (1) Berdan Primer. It is primer without anvil. (2) Boxer Primer. It is fitted with an anvil.

PRIMING MIXTURE: Primer/cap composition.

PROBABILITY: A mathematical concept which determines the chances of an occurrence in a particular way out of a number of ways in which the occurrence can take place with equal facility.

PROGRESSIVE POWDER: The propellant which produces increasing volumes of gases as the burning progresses.

PROHIBITED FIREARMS and AMMUNITION: These are those firearms and ammunition for which the possession by the public is prohibited. The arms and ammunition used by the services in India, for example, are prohibited.

PROJECTILES: A common name given to all the missiles fired from firearms.

PROOF MARKS: The certification marks on a firearm that an authority has tested the firearm, and it is fire-worthy.

PROPELLANTS: The materials used in cartridges to propel the projectiles.

PROVISIONAL PROOF: The testing marks on the barrel before assembling the complete firearm.

PUMP ACTION: A mechanism in which the extraction, the ejection, the reloading and the cocking is done through the backward and the forward motion of a specially constructed fore-end. Also called slide action or Trombone action.

PUMP GUN: A gun using the pump action.

PYRITES: Iron pyrite.

QUARTER CHOKE: A barrel with a constriction of about a quarter millimetre.

RAMROD (= rammer): A metal rod used to push the powder, the projectiles and the wads into the barrel of a muzzle-loading firearm. Also a cleaning rod of wood or metal.

RANGE: (1) The distance travelled by a projectile. (2) The place where firing practice is done.

RECOIL: The rearward movement of firearm, on firing.

RECOILLESS GUN: The gun with negligible recoil; not common in small arms, though modern assault rifles like AK 47 or AK 74 have arrangements to reduce the recoil.

REMAINING VELOCITY: The velocity of a projectile left at the given time or place.

REPEATER: A single-barrelled firearm with a magazine in which the firing can be repeated without re-loading.

RESUSCITATION: Figuring out erased or filed off numbers and designs by chemical or other processes.

REVOLVER: A handgun with a revolving wheel enabling the user to fire several shots without re-loading.

RICOCHET: The skipping of a projectile from the surface of the target when it strikes the same at low angle and moves in a different direction.

RIFLE: A shoulder firearm having a barrel with rifling.

RIFLED SLUG: A projectile having rifling on its outer surface, fired from a shotgun.

RIFLING: The spiral grooves in rifled barrels. Also the process of creating the grooves in a barrel.

RIM: The projecting edge of the base around the cylinder of the cartridge case.

RIM-FIRE CARTRIDGE: A cartridge in which the initiating mixture is placed in the fold of the rim.

RIMLESS CARTRIDGE: Cartridge without rim are fired from automatic or semi-automatic arms.

ROTAX: A big game hunting lead projectile constructed to maintain aim and range on firing from a shotgun through spin it acquires while moving through a rifled barrel.

SABOT: Device attached to projectiles to prevent damage to the latter from the barrel and *vice versa*.

SAFETY: A device that prevents functioning of firing mechanism of a firearm when the device is positioned at the safe position.

SCANNING ELECTRON MICROSCOPY: A comparatively new technique by which surface structure can be studied in details at very high magnifications the pictures obtained are stereoscopic and resolution is very high. Details in section 9.5.11.

SCORCHING: The burning of the skin or the target surface by the hot gases or flame etc. when the firearm is fired from a close range.

SCRAPE MARKS: The marks produced by firing pin (also by other parts) when it scrapes the base of the cartridge.

SEAR: The device to link the striker and the trigger.

SECTIONAL DENSITY (SD): The ratio of the weight of the projectile and cross-sectional area:

$$\mathbf{SD} = \frac{\mathbf{W}}{\pi^2}$$

SEMI-AUTOMATIC FIREARM (= SELF LOADER): A firearm which fires, ejects and reloads itself on just pressing the trigger when the firearm is already loaded. Each firing needs re-pressing the trigger.

7.62 mm semi-automatic service rifle. The replacement of the latter with 5.56 rifle as the service rifle has also been done.

SHELL: The cartridge case or a cartridge.

SHOCK: The dropping of blood pressure suddenly due to emotional disturbance, extreme fright or pain.

SHOTGUN: A smooth bore, short range, shoulder firearm, firing usually multi-projectile charge.

SHOTGUN RANGE FORMULA*:* D (pellet spread dia. in cm.) = 3 R (range in metres), for a half choke barrel.

SIGHTS: An arrangement usually consisting of two projections near the two ends (top) of the barrel of a firearm along which the shooter sees the target to aim it accurately.

SILENCER: The device to reduce the sound created in the firing process. It is usually a muzzle attachment, cylinder filled with baffles around a central hole which permits the passage of the bullets. It has a number of hole on it. The baffles and holes can be part of the barrel itself.

SKID MARK: The scratches on a bullet due to the sliding of the bullet before it sets in the grooves. The slippage marks are frequently seen in bullets fired from revolvers.

SLIDE ACTION: See Pump Action.

SLING: A leather or canvas strap used as an aid to carry a firearm.

SLIPPAGE MARKS: Skid marks.

SLUG: A lead piece of varied shapes used as projectile.

SMALL ARMS: Firearms which can be operated by an individual without mechanical aid. They have calibre less than one inch.

SMOKELESS POWDER: The propellants prepared from nitroglycerine and nitrocellulose. Technically a misnomer as these powders do produce smoke though much less than produced by gunpowder.

SMOOTH BORE: A firearm having smooth (unrifled) barrel.

SNAP SHOT: A shot fired without taking proper aim.

SOLID-FRAME REVOLVER: A revolver in which the wheels open to one side for loading and unloading.

SODIUM RHODIZONATE: A reagent to identify lead.

SPENT BULLET: A fired bullet which has lost most of its velocity and consequently unable to cause any serious damage.

SPIN: The revolving motion of a bullet round its own axis.

SPLIT BALL: A smooth bore firearm projectile which has slits on its body and breaks up into fragments on hitting the target.

SPORTING RIFLE: A rifle used for hunting or target practice.

SPITZER BULLET: Cylindro-conoidal bullet.

STANDARD CHOKE: A barrel in which the diameter near the muzzle is narrowed continuously.

STEN GUN: An automatic short-barrelled rifle.

STEREOSCOPY: A three dimensional microscopic technique. The stereomicroscope has two objectives and two eyepieces to form overlapping images simultaneously to give the three dimensional effect.

STIPPLING (= Tattooing = peppering): The embedding of unburnt or semi-burnt powder particles in the skin or at the target.

STOCK: The thick wooden (other materials especially plastics are also used) hind part of a shoulder firearm.

STOPPING POWER: The incapacitating power of a bullet.

STREAM-LINED BULLET: The projectile having pointed ends on both sides.

STRIAGRAPHY: The study and recording presence of striations on a surface, with the help of a fine stylus.

STRIATIONS: Linear marks on fired ammunition especially on bullets.

STRIKER: Firing pin.

STRIKING VELOCITIES: The velocity of the projectile at the time of striking the target.

STUD GUN: Cattle gun.

SUMMIT: Vertex.

SUMMIT HEIGHT: Vertex height.

SUPERIMPOSITION # Placing the photograph (or image or transparency) of one set of marks (say, obtained from the test exhibit) over the photograph (or the image or transparency) of the second set of the marks (say, on the crime exhibit).

TAIL-SPLASH (= BACK SPLASH/SPATTER): It is the throwing out of the cut or the torn body tissues backward through the entrance wound.

TATTOOING: Imbedding of un-burnt or semi-burnt powder particles inside the skin, or at the target in a firearm shooting from a close range.

TOP BREAK ACTION: Common in shotguns and in some revolvers. The barrel(s) and the action are link through a strong hinge, usually at the top. Moving of the hinge away make it possible to turn the barrel(s) down. Thus loading or unloading of the firearm can be done. See breech loader and break Frame Revolver.

TOUCH HOLE: A hole in the pan of an early match-lock. Flint-lock or wheel-lock firearm. Powder was placed in the pan and put on fire. The fire spread through the touch hole to the main charge of the powder inside the barrel.

TOY GUN: A toy which looks like a firearm.

TRACER BULLET: A bullet which traces its trajectory by leaving a smoke streak along the route.

TRACE ELEMENTAL PROFILE: It is the qualitative and quantitative analysis picture of various elements present in a give substance, say of the lead projectile. For detail see Chapter 7. It helps to identify the source of projectile by comparing it with those of the suspected sources.

TERMINAL BALLISTICS: See ballistics.

TRANSITIONAL BALLISTICS: It studies transitions of projectiles when changing from one medium to another. Ballistics is affected by jump and side swings, etc. It is negligible in small arms Ballistics.

TRAJECTORY: The path of a projectile from the muzzle to the target.

TRIGGER: A part of the mechanism of a firearm which on pressing, fires a cartridge when the firearm is loaded and ready for fire.

TRIGGER GUARD: A curved steel strip which protects the trigger from accidental pulling.

TRIGGER PULL: The minimum weight (pull) on the trigger which releases the hammer or a firing pin of a cocked firearm—measured in kilograms or pounds. For revolvers it is:

Single Action Revolver = 1.2 to 2 Kg.

Double Action Revolver = 5 - 6 Kg.

TROMBONE ACTION: See pump action.

TWIST: See pitch.

VACUUM TRAJECTORY: The path of a projectile moving in a vacuum.

VARIABLE CHOKE (= Poly choke): A tubular attachment for the muzzle of the shotguns. By manipulating the tube the degree of the choke can be varied.

VERTEX: The highest point of a trajectory.

VERTEX HEIGHT: The height at vertex.

VIBRATIONS: The almost imperceptible rapid to and fro movement of a firearm on firing.

WAD: The cardboard (or plastic) disc(s) in the cartridges to separate the powder charge etc. from other items usually in shotguns.

WADCUTTER BULLETS: For shooting at paper targets, the best bullet is one that will punch a perfect hole through the target. These bullets are called wadcutters. They have a very flat front, often with a relatively sharp edge along the perimeter. The flat front punches out a large hole in the paper, close to, if not equal to, the full diameter of the bullet

WILDCAT CARTRIDGE: A non-standard cartridge.

WIND DEFLECTION: The drift of the projectile due to the wind.

WIRE-PATCH BULLET: A bullet enclosed in a wire jacket.

WOUND BALLISTICS: The study of the formation of the wounds and the influence of the projectile, range, velocity and the target in the wounding phenomena, etc.

YAW: The changing angle which the horizontal axis of a projectile makes with the line of flight.

ZEROING: The sight adjustment so that the bullet strikes the target in the bull's eye at the range at which zeroing has been done.

ZIP GUN: It is an improvised firearm.

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RELEVANT LITERATURE

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